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DRILLING PROGRESS ISSUE

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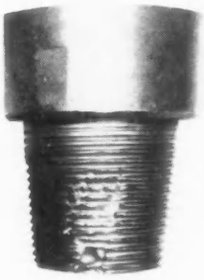

## CARE AND MAINTENANCE OF TOOL JOINTS

**First of a three-part discussion of types of tool joint failures and how they can be prevented**

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# WORLD OIL

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SPECIALIZED FOR EXPLORATION, DRILLING AND PRODUCING OPERATIONS AND MANAGEMENT

**ENGINEERING PRACTICES MANUAL NUMBER 3**

Care and Maintenance of Tool Joints

Part 1

Sterling G. Marshall and C. R. Frederick

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# A Quick Look

## at this issue

☐ **How seven contractors have improved their economic positions . . .** Despite stiff competition and rising costs, there still is a promising future ahead for drilling contractors. This was the general conclusion reached in exclusive WORLD OIL interviews with seven successful contractors. Starting on **Page 105,** you will find their ideas on improving operating practices, upgrading personnel, turnkey operations, cutting costs, deep drilling and going abroad tips.

☐ **What is the future of big-hole drilling? . . .** Is the contractor prepared to drill large diameter holes? To answer these questions and others regarding the potential of large diameter drilling, WORLD OIL interviewed an equipment manufacturer, a service company and a drilling contractor to obtain their views. For a timely and highly informative discussion of this potential business alternative for the drilling industry, turn to ..... **Page 108**

☐ **How to forecast accurate drilling costs . . .** As competition increases, drilling contractors are finding it more important than ever to forecast every cost factor accurately in preparing drilling bids. At present, variable costs account for 65-75 percent of the footage price, with net drilling time and bits making up the remainder. For a proven method designed to help you accurately forecast variable costs, turn to .... **Page 112**

☐ **Care and maintenance of tool joints. (Part 1) . . .** Because costly fishing jobs can result from improper inspection of tool joints, the importance of these inspections are emphasized by drilling contractors. See **Page 117** for the first of a three-part discussion of

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types of tool joint failures and how they can be prevented, plus a complete report on proper care and maintenance.

☐ **Check lists minimize accidents while drilling with gaseous fluids . . .** With the increased use of air and gas drilling, greater emphasis must be placed on safe operational practices. A common understanding of safety requirements and practices must be observed between the operator, drilling contractor, and air service contractor. For a handy checklist that will help make such cooperation possible, plus an informative discussion of the various safety requirements and practices, turn to ..... **Page 128**

☐ **Drift indicator cuts drilling time . . .** Increased penetration rates and an over-all reduction in drilling time are being reported by contractors using a signaling drift indicator that soon will be available for commercial use. Positioned in a sub just above the bit, the tool signals the hole angle in increments of one-half degree. For more information on this new development, plus several case histories, turn to ..... **Page 134**

☐ **A new look at oil imports . . .** Has the ratio of oil imports to U.S. demand increased since 1954? What is the Oil Import Administration's attitude toward residual imports? Are tariffs the answer to the import problem? For candid answers to these and other questions of top concern to the oil industry, as explained by the new Oil and Gas Administrator, Lawrence J. O'Connor, Jr. in an exclusive WORLD OIL interview, turn to ..... **Page 136**

☐ **How Gulf automated a 74-well lease in West Texas . . .** A new automation project specifically designed to handle San Andres crude production has recently been completed in West Texas. The installation includes complete automatic well testing facilities with data printout, a central battery treating system for all production, monitoring system for "bad" oil production, LACT and shut-in devices for allowable attainment, power failure, etc. For complete details on this unique installation, see ..... **Page 139**

☐ **Home markets offer growing outlet for Texas and Louisiana gas reserves . . .** Current gas reserve discovery levels in Texas and Louisiana will fall far short of meeting growing demands on the industry in the next five years—if proper incentives are not provided. The statistics supporting this statement, plus a revealing report on the inroads natural gas and imports have made on U.S. crude oil production, are presented by one of the natural gas industry's top consultants, starting on ..... **Page 145**

☐ **Downhole camera helps solve production problems . . .** A 4½-inch OD x four-foot long borehole camera is being used to photograph actual conditions in the well. Although the tool is presently applicable only in dry or gas filled wells, it has provided valuable data on hydraulic fracturing results, fishing operations, cement jobs, hole configuration, etc. This article includes a number of pictures obtained downhole with an interpretation of each. For additional information, see ..... **Page 150**

☐ **Dual completion workover program increases production . . .** Cities Service Oil Company has initiated a dual completion workover program in Dollarhide field, West Texas, which is paying off in increased production and improved operational procedures. Features of the program include extended perforations, fracture treatments and replacement of single string dual installations with two strings of tubing equipped with retrievable gas lift valve mandrels. Because of the program, Cities Service has recovered approximately 337,300 barrels of additional oil as of December 1959. For a complete description of workover procedures, equipment involved and results obtained, see ..... **Page 153**

☐ **New perforators ease slim hole completion problems . . .** Increased application of single and multiple tubingless completion techniques has resulted in development of new, small OD perforators as well as unusual orientation methods. The two general types of guns described in this article are expendable; however,

**Watch for November's Special Gulf Coast Issue . . .**

WORLD OIL editors are putting the finishing touches on the most comprehensive Gulf Coast Issue yet published. All technical material will be directly applicable to Texas-Louisiana Gulf Coast operations, and will include articles on:

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- New automatic marine production installations
- Latest Gulf Coast geology
- How to complete high pressure gas wells
- New wireline workover techniques

***and***

- Engineering Practices Manual No. 3—Care and Maintenance of Tool Joints (Part 2).

***and coming in December . . . a complete***

one is retrievable while the other is not. The retrievable type is virtually debris free and can withstand hydrostatic pressures of 20,000 psi. Also, the retrievable tool can be used to perforate upper zones of conventional multiple wells without pulling pipe. See.....**Page 157**

☐ **How to use the continuous velocity logger in core and shot holes . . .** Seismic exploration is being improved thru the use of a miniaturized continuous velocity logger in core holes and shot holes. Not only are more accurate velocity control data acquired, but these shallow logs also provide excellent correlations. Continued improvements in instrumentation and utilization indicate routine use of the velocity logger in core, shot, and slim holes in the future. See .....**Page 160**

☐ **Where is the basement? . . .** Detailed information on the depth to basement in Texas, Kansas, the Appalachians, Algeria, Indonesia, and other oil-productive regions is summarized in this unusual article, which is intended not only for geologists but for others interested in learning of economic limits for deep drilling in various areas. This specific discussion is followed by a more general one as to what constitutes basement. See ..**Page 170**

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A sizable part of WORLD OIL's editorial program is ignited by readers themselves through letters to the editor. Not only do we welcome and appreciate your reaction to WORLD OIL editorial articles, but also we earnestly invite you to tell us what subjects you would like to see us cover.

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## *Oil Industry in Brief*

Here are the latest industry trends, revealed by WORLD OIL and industry research:

Demand increases slowly. Gasoline demand was up only 2.3 percent during first 8 months of 1960, while distillate demand increased 4.2 percent . . . See Page 25.

Gasoline stocks increase. Totaling 189 million barrels on August 31, U.S. gasoline stocks were 7 million barrels or 3.9 percent over same 1959 date . . . See Page 25.

Refinery runs too high. Key to improved market conditions is refinery runs. They must be cut more than 250,000 barrels daily from 8,250,000 barrels per day average in July-August if inventories are to reach realistic levels . . . See Page 25.

Drilling activity down. Rig totals, U.S. well completions and footage drilled increased in August—but still continued far below 1959 levels . . . See Page 28.

Oil completions drop sharply. Operators completed 14,642 oil wells during first 8 months, down 14.7 percent from same 1959 period—while gas completions increased 4.8 percent to 12,016 . . . See Page 28.

Import ratio increases. Since 1954, the ratio of U.S. petroleum imports to demand has jumped from 4.9 percent to 20 percent in District 5, while the ratio has averaged about 15 percent in Districts 1-4 . . . See Page 136.

Natural gas makes rapid gains. By 1964, intra-interstate demands for Texas and Louisiana natural gas are expected to reach 17.7-21 trillion cubic feet annually . . . See Page 145.

Natural gas-imports curb crude production. Between 1946 and 1959, marketed production of natural gas increased 183 percent and crude oil imports increased 305 percent—while marketed production of crude oil increased only 48 percent . . . See Page 145.

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***Indexed by Industrial Arts Index and Engineering Index***

# Looking Ahead

***Jersey Standard introduces new drilling tools*** . . . Jersey Production Research Company scientists have announced four new milestones in drilling technology and research:

• **Fluid entry analyzer**—locates points of entry of water, oil and gas in a producing well and determines fluid density by measuring radiation intensity of gamma rays that are emitted by radioisotope as it passes through the fluids.

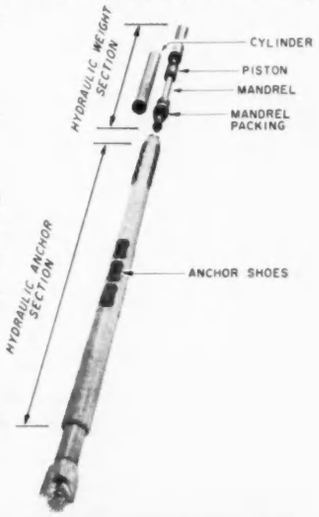
**Combined with Humble Oil & Refining's inflatable packer flowmeter,** the new logging device will permit, for the first time, simultaneous measurement of the location, direction, amount, and type of fluid entering a well. Both tools can pass through 2-inch tubing.

• **Hydraulic wall-anchored drill collar**—to apply high bit weight without use of conventional drill collars.

**Tool is six inches in diameter,** 37 feet long, weighs only 2,200 pounds or about 5 percent as much as conventional collars—yet can exert force of 40,000 pounds at a pressure drop of 1,000 psi across the bit. Hydraulic unit will have first use in shallow areas which limit drill collar length and require high bit weights.

**In recent field test near Midland, Texas,** tool drilled 500 feet in 45 rotating hours. Present tool must be reset after drilling two feet. However, another is being developed that will reset automatically.

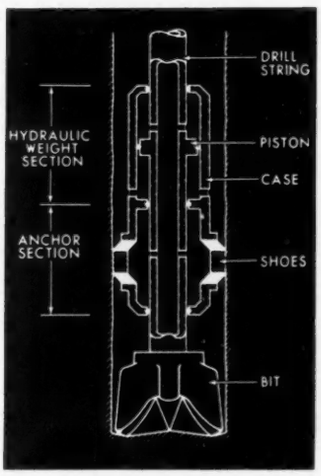
**Complete technical report on new drill collar will be published in November World Oil.**




• **Down-hole recorder**—will allow bit designers to obtain reliable down-hole measurements to establish actual drill bit environments, without resorting to deductions.

**Device is 6¾ inches in diameter and 15 feet long,** includes an eight-channel tape recorder only four inches in diameter. New tool measures weight and torque on bit; vertical, angular and lateral accelerations; pressure outside and inside drill pipe; and temperature. Measurements are made with strain gages.

**Ten tests at shallow depths have proved tool to be field-worthy.** Although tests still are being analyzed, it already is apparent that bits are subjected to a wider range of loads and frequencies than had previously been considered possible.




**Hydraulic Wall-Anchor Drill Collar**

• **Special high pressure chamber**—to measure strength of rocks under pressures they would be subjected to deep in the earth, thus providing the industry with a better understanding of how drill bits penetrate rocks under bottom hole conditions.

**Chamber is designed to subject a cylindrical specimen of rock to three independent pressures** ranging up to 15,000 pounds per square inch. The pressures are used to simulate fluid pressure in the hole, fluid pressure in the formation, and weight of earth above section being drilled. After these pressures are applied, a single chisel simulating one tooth of a bit, is dropped on the rock specimen. Resulting loads, displacements, and volume of rock removed are measured and recorded.

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GUEST EDITORIAL

**By W. L. McClusky**
President, AAODC
Dallas

# The contractor's plight is an industry problem

THE PRODUCING SEGMENT of the U.S. petroleum industry faces many varied problems today. Basically, however, most of these problems get back to a financial squeeze caused by stringent curtailment of production and low prices in the face of rising costs. This situation has resulted in producers adopting drastic measures in order to achieve reduced operating expenses.

Naturally, some of these actions have had undesirable repercussions upon affiliated or dependent segments of the petroleum industry. Included among the groups who have felt repercussions from the slowdown and economy wave in producer activities is the contract drilling industry.

As a part of their economy move, producers have substantially reduced the volume of funds spent for drilling operations. Two means have been utilized by producers to trim their drilling expenditures. One step has been to drill far fewer wells. Approximately 25 percent less wells will be drilled in the U.S. during 1960 than in 1956, and even 15 percent less than the curtailed volume drilled in 1959. Drilling costs have been further reduced by materially lower contract drilling prices, and also by contractors assuming more and more of the duties and operations formerly performed or paid for by producers.

In turn, these trends have caused the economic position of the U.S. contract drilling industry to deteriorate drastically. Reduced drilling rates have sharply curtailed the quantity of contract drilling business, leaving many rigs idle too much of the time. Intense cut throat competition for available work has become more and more prevalent. Contract prices have continued downward. Costs of supplies and services used by contractors have continued upward. The performance of additional duties and operations have greatly increased contractor expenses.

Conditions are reaching such a critical stage in the contract drilling industry that there is increasing doubt as to how much longer contractors will be financially and physically capable of economically satisfying the drilling requirements of producers. This could become a serious additional problem for producers, as well as for contractors. Before long, troubles of the contract drilling business may add to rather than help to alleviate producer financial conditions. This is particularly applicable to the independent producer.

Producers now depend upon the services of contractors to perform 96 percent of all U.S. drilling operations. Under this condition, producers need to have the oil well contracting business remain adequate and efficient to economically perform the services desired by producers.

Under present distress conditions, we see an increasing number of drilling contractors going out of business, a reduction in the number of rigs capable of efficiently performing the services expected of contractors as new rig equipment purchases fall far below normal replacement levels, and the loss of skilled rig personnel to other industries where employment is steadier, living conditions better, and wages often higher.

An adequate supply of both well-equipped rigs and skilled rig crewmen is essential to high-speed and trouble-free and less expensive drilling operations. Conversely, inexperienced manpower and poorly equipped rigs mean higher drilling costs. Whenever the quality and quantity of good rigs and trained rig personnel decline below adequate levels, drilling performance will deteriorate rapidly and costs will be greater.

Such trends inevitably will affect producers, as well as contractors. In the end, producers must pay for the petroleum industry's drilling operations. Contractors have no source of income except the funds provided by producers.

Should the quality and quantity of available rigs and rig manpower decline to the point to no longer be capable of efficiently satisfying the requirements of the producing branch of the industry, the serious burden of putting the contracting business back on its feet necessarily must fall on producers.

*How one operator used D-Gassers to*

# reduce gas well costs by about $55,000

A Canadian operator — drilling deep gas wells in the Alberta foothills — is using the SWACO D-Gasser to save about $55,000 per well. Here is how he does it:

This operator, who was developing a gas field in the Alberta foothills, was encountering a gas-cutting problem during drilling that increased costs seriously. The problem was high-pressure, low-volume gas accumulations in a shale section above the main pay or between pay zones.

Until this shale section was reached, mud weight of 10 pounds per gallon was carried. When this section was being penetrated, however, severe gas cutting and "blowing" occurred. The gas cutting then persisted in the form of a two to three hour trip gas for the remainder of the well.

### Practice before using D-Gasser

The operator circulated until he could build mud weight up to 11-13 pounds per gallon to control the gas cutting. Lost circulation in the pay section frequently occurred with the heavy mud, and a great deal of lost circulation material was often required. The cost of mud materials to control both gas and lost circulation ran $25,000 or more per well.

Initially, it took anywhere from two days to a week to condition the mud, and in one case it was necessary to set casing before drilling could proceed. In addition, several hours of rig time were lost after each trip gunning out the trip gas.

### Practice when using D-Gasser

With a D-Gasser installed, the operator merely starts it up when the gas cutting occurs. Occasionally the preventers have to be closed, and the well placed on choke for a few hours. However, the whole job of mud conditioning can be accomplished in less than one day without increasing the mud weight. Moreover, penetration rates and bit life while drilling using the lower weight muds are substantially improved. Total savings in drilling costs amount to approximately $30,000 per well.

To summarize, the operator has found he saves $25,000 or more in mud costs and something like $30,000 in rig time and other drilling costs.

This case is just one of many examples that prove the SWACO D-Gasser is more than just a safety device to be used for wildcat drilling. It makes possible important reductions in overall well costs in any area where gas cutting is a problem. Contact your nearest SWACO representative to find out just how much D-Gassers can reduce your costs. Also ask him how SWACO Clayjectors and D-Sanders can further reduce drilling costs.

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# Better markets promise good third quarter

**Prices were maintained in July, August and September, following improvement in June. But continuance of firm markets henceforth will depend on curtailment of refinery runs and the avoidance of surpluses of distillate and gasoline**

THE INDUSTRY continued to have generally good markets in August and the first half of September, following the improvement of June and July.

It was indicated, therefore, that oil company earnings would be generally favorable for the third quarter of this year. They had been fairly good in the second quarter, with benefit of better product prices in June.

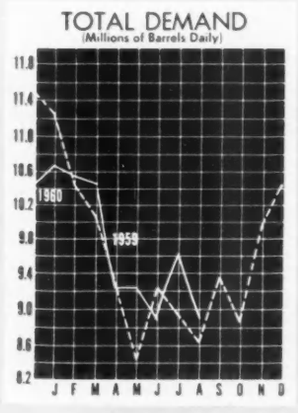
**Gasoline.** Fortunately, gasoline prices continued to hold at improved levels at mid-September, in spite of some misgivings. Gasoline stocks were seasonally reduced during August, as demand was strong at the height of the vacation period.

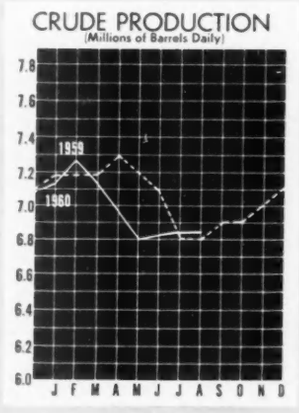
But the stocks of 189 million barrels at the end of the month were 7 million barrels or 3.9 percent larger than those held August 31, 1959. And it was feared that these inventories might prove excessive after Labor Day and the end of the vacation season. Although demand was strong in August, it was up only 2.3 percent for the first 8 months of 1960, having lagged earlier in the year.

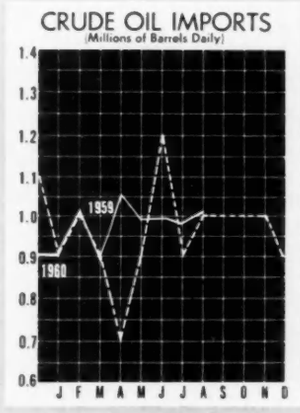
**Distillate.** The markets for heating oil also have held steady during the past few months, following improvement in prices in the spring. Stocks of distillate fuel oil are quite ample, but residual fuel oil stocks are relatively low. As cooler weather approaches, the outlook for fuel oil markets is promising. Demand is not growing sharply as in the past, but so far this year, distillate demand has been up 4.2 percent over last year, and residual demand is up slightly.

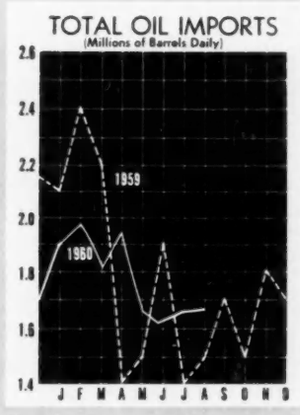
Distillate fuel oil stocks were seriously excessive in the later part of 1959 and early part of 1960 and prices deteriorated. A substantial part of the surplus was liquidated by a cold

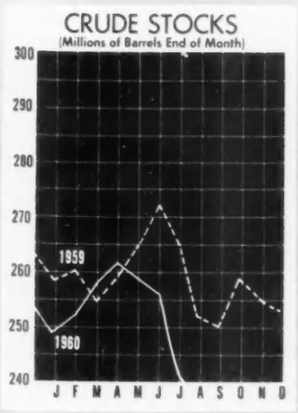
## Petroleum Trends...

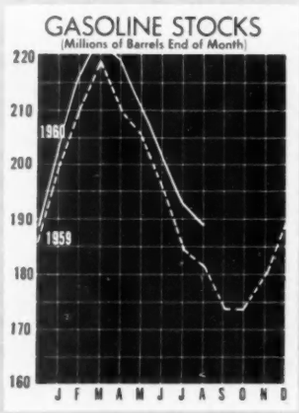


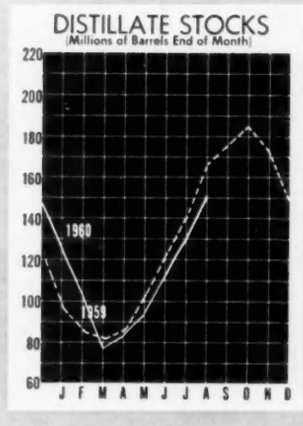



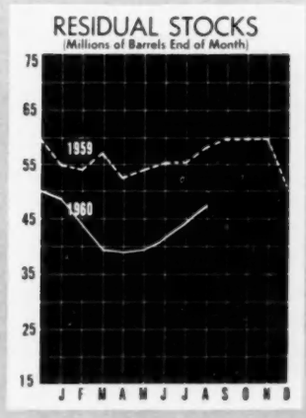



## U.S. Petroleum Demand and Supply (Thous. Bbls. Daily)

| ITEM | AUGUST 1960 | AUGUST 1959 | AUGUST % Diff. | July 1960 | JANUARY-AUGUST 1960 | JANUARY-AUGUST 1959 | JANUARY-AUGUST % Diff. |
|---|---|---|---|---|---|---|---|
| DEMAND | | | | | | | |
| All Oils, Total Demand | 8,922 | 8,680 | + 2.8 | 9,465 | 9,833 | 9,567 | + 2.8 |
| Domestic Demand | 8,702 | 8,456 | + 2.9 | 9,255 | 9,618 | 9,320 | + 3.2 |
| Export Demand | 220 | 224 | — 1.8 | 210 | 215 | 247 | —13.0 |
| Gasoline, Total Demand | 4,657 | 4,331 | + 7.5 | 4,533 | 4,225 | 4,128 | + 2.3 |
| Distillate, Total Demand | 1,176 | 1,069 | +10.0 | 1,246 | 1,856 | 1,782 | + 4.2 |
| Kerosine, Total Demand | 264 | 143 | +84.6 | 284 | 338 | 276 | +22.5 |
| Residual, Total Demand | 1,256 | 1,170 | + 7.4 | 1,352 | 1,618 | 1,616 | + 0.1 |
| Other Oils, Total Demand | 1,569 | 1,967 | —20.2 | 2,050 | 1,796 | 1,765 | + 1.8 |
| CHANGE IN STOCKS | | | | | | | |
| All Oils, Change in Stocks | +473 | +429 | | —65 | —69 | +177 | |
| NEW SUPPLY | | | | | | | |
| Total New Supply | 9,395 | 9,108 | + 3.2 | 9,400 | 9,764 | 9,744 | + 0.2 |
| Domestic Production, Total | 7,707 | 7,622 | + 1.1 | 7,735 | 7,930 | 7,954 | — 0.3 |
| Crude Oil | 6,837 | 6,766 | + 1.0 | 6,835 | 7,010 | 7,087 | — 1.1 |
| Natural Gas Liquids | 870 | 856 | + 1.6 | 900 | 919 | 867 | + 6.0 |
| Imports, Total | 1,688 | 1,487 | +13.5 | 1,665 | 1,835 | 1,790 | + 2.5 |
| Refined Products | 677 | 521 | +29.9 | 682 | 824 | 839 | — 1.8 |
| Crude Oil, Total | 1,011 | 966 | + 4.7 | 983 | 1,011 | 951 | + 6.3 |
| Crude, East of California | 666 | 660 | + 0.9 | 742 | 743 | 732 | + 1.5 |
| CRUDE RUNS | | | | | | | |
| Crude Runs to Stills | 8,235 | 8,081 | + 1.9 | 8,259 | 8,101 | 8,034 | + 0.8 |
| Domestic Crude | 7,189 | 7,118 | + 1.0 | 7,175 | 7,084 | 7,088 | — 0.1 |
| Foreign | 1,046 | 963 | + 8.6 | 1,084 | 1,017 | 946 | + 7.5 |

## U.S. Stocks of Oils (Million Bbls. at End of Month)

| KIND OF OIL | TOTAL IN U.S. August 1960 | TOTAL IN U.S. August 1959 | TOTAL IN U.S. % Diff. | TOTAL IN U.S. July 1960 | EAST OF CALIFORNIA August 1960 | EAST OF CALIFORNIA August 1959 | EAST OF CALIFORNIA % Diff. | EAST OF CALIFORNIA July 1960 |
|---|---|---|---|---|---|---|---|---|
| All Oils | 799.8 | 832.4 | — 3.9 | 785.6 | | | | |
| Crude Oil | 234.7 | 253.1 | — 7.3 | 242.5 | 204.0 | 217.4 | — 6.2 | 216.3 |
| Gasoline | 189.0 | 181.9 | + 3.9 | 193.4 | 162.1 | 155.3 | + 4.4 | 164.3 |
| Distillate Fuel Oil | 152.4 | 164.1 | — 7.1 | 131.1 | 138.2 | 149.3 | — 7.4 | 117.6 |
| Kerosine | 33.7 | 31.2 | + 8.0 | 30.2 | 32.2 | 30.8 | + 4.5 | 28.8 |
| Residual Fuel | 47.0 | 57.9 | —18.8 | 43.2 | 31.4 | 30.7 | + 2.3 | 28.9 |
| Other Oils | 143.0 | 144.2 | — 0.8 | 145.2 | | | | |

## U. S. Crude Oil Production, by States (Thous. Bbls.)

| STATE or DISTRICT | Daily Average for Month August 1960 | August 1959 | % Diff. | July 1960 | Total, January-August 1960 | 1959 | % Diff. |
|---|---|---|---|---|---|---|---|
| Alabama | 16.9 | 12.4 | + 36.3 | 17.3 | 4,438 | 3,273 | + 35.6 |
| Arkansas | 81.5 | 62.9 | + 29.6 | 79.7 | 19,229 | 18,426 | + 4.4 |
| California | 833.3 | 841.5 | — 1.0 | 836.8 | 203,268 | 205,100 | — 0.9 |
| Colorado | 131.1 | 126.4 | + 3.7 | 128.9 | 31,351 | 30,589 | + 2.5 |
| Florida | 1.0 | 1.2 | — 16.7 | 1.0 | 257 | 283 | — 9.2 |
| Illinois | 218.6 | 212.5 | + 2.9 | 215.5 | 52,691 | 52,087 | + 1.2 |
| Indiana | 32.3 | 32.2 | + 0.3 | 32.7 | 7,751 | 8,083 | — 4.1 |
| Kansas | 296.9 | 308.9 | — 3.9 | 292.6 | 74,236 | 79,689 | — 6.9 |
| Kentucky | 57.4 | 70.9 | — 19.1 | 58.8 | 14,611 | 18,057 | — 19.1 |
| Louisiana | 1,068.5 | 964.6 | + 10.8 | 1,063.9 | 260,493 | 230,066 | + 13.2 |
| North Louisiana | 111.4 | 125.5 | — 11.2 | 112.5 | 29,592 | 29,733 | — 0.5 |
| South Louisiana | 957.1 | 839.1 | + 14.1 | 951.4 | 230,901 | 200,333 | + 15.3 |
| Michigan | 41.3 | 28.8 | + 43.4 | 39.5 | 9,168 | 6,584 | + 39.2 |
| Mississippi | 134.3 | 135.4 | — 0.8 | 137.3 | 34,231 | 30,637 | + 11.7 |
| Mo.-So. Dak.-Tenn. | 0.8 | 0.6 | + 33.3 | 0.7 | 207 | 44 | +370.5 |
| Montana | 83.2 | 82.6 | + 0.7 | 82.6 | 19,981 | 19,968 | + 0.1 |
| Nebraska | 66.4 | 70.1 | — 5.3 | 66.9 | 15,790 | 15,302 | + 3.2 |
| Nev.-Wash.-Alaska-Ariz. | 1.0 | 0.7 | + 42.9 | 0.9 | 196 | 136 | + 44.1 |
| New Mexico | 290.3 | 284.8 | + 1.9 | 289.8 | 71,962 | 69,860 | + 3.0 |
| Southeast New Mexico | 254.5 | 243.0 | + 4.7 | 252.2 | 61,293 | 60,427 | + 1.4 |
| Northwest New Mexico | 35.8 | 41.8 | — 14.4 | 37.6 | 10,669 | 9,433 | + 13.1 |
| New York | 4.7 | 5.4 | — 13.0 | 4.9 | 1,223 | 1,313 | — 6.9 |
| North Dakota | 65.5 | 48.8 | + 34.2 | 59.3 | 14,056 | 11,946 | + 17.7 |
| Ohio | 12.0 | 14.9 | — 19.5 | 12.3 | 3,257 | 3,761 | — 13.4 |
| Oklahoma | 484.8 | 492.4 | — 1.6 | 507.3 | 128,469 | 131,527 | — 2.3 |
| Pennsylvania | 16.9 | 16.2 | + 4.3 | 16.5 | 4,185 | 4,000 | + 4.6 |
| Texas | 2,440.2 | 2,480.7 | — 1.6 | 2,435.3 | 627,091 | 669,713 | — 6.4 |
| Dist. 1: South Central | 43.2 | 44.7 | — 3.4 | 44.0 | 10,739 | 11,084 | — 3.1 |
| Dist. 2: Middle Gulf | 103.7 | 106.5 | — 2.6 | 105.3 | 27,840 | 29,244 | — 4.8 |
| Dist. 3: Upper Gulf | 344.0 | 349.6 | — 1.6 | 345.5 | 87,330 | 95,103 | — 8.2 |
| Dist. 4: Lower Gulf | 182.7 | 175.9 | + 3.9 | 178.2 | 45,931 | 47,421 | — 3.2 |
| Dist. 5: East Central | 26.4 | 28.2 | — 6.4 | 26.5 | 6,656 | 7,440 | — 10.5 |
| Dist. 6: Northeast | 237.8 | 237.2 | + 0.3 | 232.4 | 60,330 | 65,749 | — 8.3 |
| Dist. 7-B: North Central | 128.1 | 130.2 | — 1.6 | 126.4 | 31,598 | 33,612 | — 6.0 |
| Dist. 7-C: West Central | 112.2 | 115.9 | — 3.2 | 118.4 | 29,904 | 31,891 | — 6.2 |
| Dist. 8: West | 959.3 | 950.6 | + 0.9 | 955.7 | 248,188 | 262,519 | — 5.5 |
| Dist. 9: North | 194.6 | 205.9 | — 5.5 | 195.1 | 47,591 | 50,531 | — 5.8 |
| Dist. 10: Panhandle | 108.1 | 109.6 | — 1.4 | 107.8 | 26,474 | 26,117 | + 1.4 |
| Utah | 94.5 | 108.5 | — 12.9 | 95.7 | 25,353 | 26,876 | — 5.7 |
| Virginia | | | | | 3 | 4 | — 25.0 |
| West Virginia | 6.4 | 5.7 | + 12.3 | 6.4 | 1,517 | 1,433 | + 5.9 |
| Wyoming | 357.3 | 356.5 | + 0.2 | 352.4 | 85,515 | 83,467 | + 2.5 |
| Total, United States | 6,837.1 | 6,765.6 | + 1.1 | 6,835.0 | 1,710,529 | 1,722,224 | — 0.7 |

Sources for above 3 tables: Bureau of Mines monthly reports, except last two months based on API and B. of M. weekly reports and WORLD OIL estimates, and all Texas districts from API.

March 1960. But some surplus has persisted to now. Stocks at end of August were within 2 millions barrels of the level desirable for end of October, and it appeared that they would be at least 8 million barrels too high at that time, even with refinery runs curtailed in September and October. At mid-September, distillate prices were still holding. But the need for curtailing refinery runs and controlling distillate stocks was urgent.

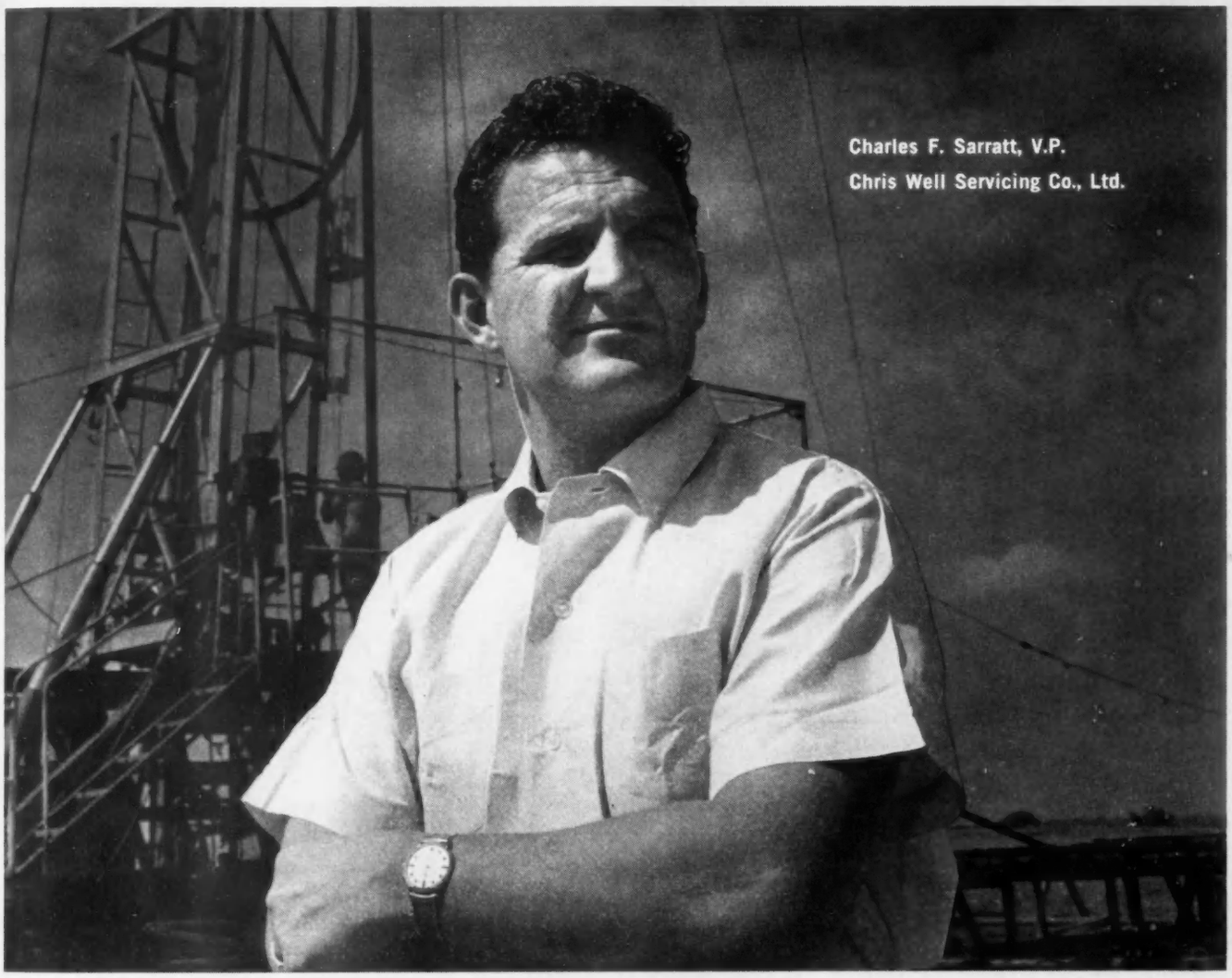
**Refinery runs.** A principal concern of the industry currently is the level of refinery runs. Crude oil production has been stringently curtailed for many months, and crude control has been importantly responsible for the better markets of the past few months. Crude stocks have been reduced to exceptionally low levels, with new supplies short of refinery runs. Strict control of crude production is expected to continue.

Refinery runs of crude have been less strictly held down. Plant operations have not depended wholly on current new supplies of oils, from production and imports. Runs to stills have been maintained at relatively high levels by supplementing new supplies with crude oil taken from storage. In this refinery runs have been higher than desirable, despite substantial curtailments by some refiners in recent months. Consequently, stocks of most products are ample, and inventories of gasoline and distillate are rather dangerously high.

**Curtailment needed.** In these circumstances, refiners henceforth must shoulder much of the responsibility for the health of the industry's markets. They will need to hold down crude runs to stills to very conservative levels in order to preserve the better markets lately achieved. Refinery runs averaged around 8,250,000 barrels daily in July and August. They should be cut somewhat below 8,000,000 bpd in coming months, according to some industry analysts.

This will be needed to avoid the accumulation of surplus stocks of heating oil in advance of the main heating season and to promote firm markets and satisfactory prices of heating oils. The moderate refinery runs will be needed also to keep the seasonal build-up of gasoline stocks in line with normal trends during the fall and winter and to help assure holding the line on gasoline prices.

# "WHY BUY A NEW RIG? BECAUSE THE RIGHT EQUIPMENT IS VITAL TO SUCCESS IN OUR BUSINESS!"



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Chris Well Servicing Co., Ltd.

"Equipment is vital to us—our continued growth depends on our ability to anticipate the future needs of our customers. We needed a self-propelled rig that would do slim hole drilling to a depth of 8,000 feet, and deep workover and deepening jobs down to 15,000 feet. The Cardwell KM250 filled the bill," says Mr. Sarratt. "We can bid on jobs the smaller rigs can't handle, and we can underbid heavier rigs by $50 to $100 a day. Moving and rig-up costs are low, and so is maintenance. We've had only one major repair in a year. The total time lost was only 12 hours, and Cardwell stood behind the rig 100%."

Chris Well deepened the Anderson-Prichard Oil Corporation's No. 1 Gray "A" from 10,832 feet to 12,032 feet—the first well to be deepened by a workover rig through the Bromide into the Oil Creek section. Savings to the operator were substantial—about $1,500 in moving and rigging-up costs, plus more than $50 per day on day rates. The KM250 actually outperformed a heavier rig—drilling the hole through a special technique in 18 days less than a conventional rig on an offset well, and making the 12,000-foot round trip in less time than the heavier rig, which was handling triples.

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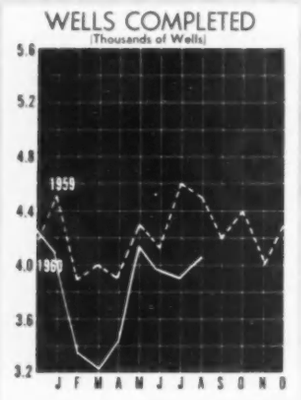
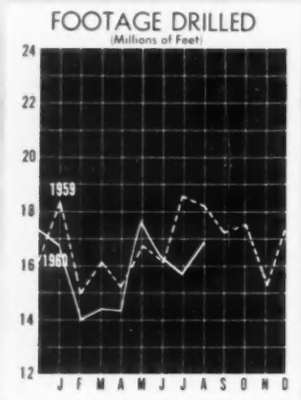
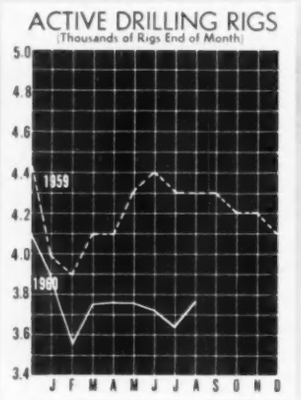
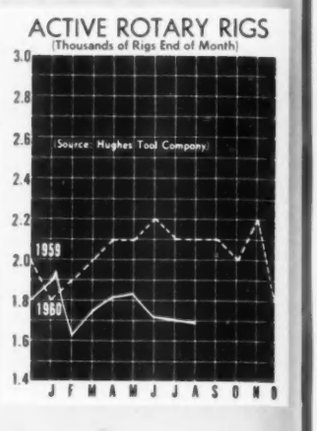
# Drilling Activities.




# Drilling continues under 1959 levels

RIG TOTALS, U.S. well completions and footage drilled in August increased over July. However, these major barometers of domestic drilling activity continued to fall below 1959 levels.

Active rigs totaled 3,777 on August 31, up 141 rigs or 3.9 percent from July 31—but, the total was down 525 rigs or 12.2 percent from the 4,302 rigs operating on August 31, 1959.

U.S. well completions in August averaged 131 wells per day, up 5 wells per day or 4 percent from July. However, the average was down 11.5 percent from the 148 wells per day completed during August 1959.

Footage drilled averaged 548,400 feet per day during August, up 7.6 percent or 38,700 feet per day from July. Even so, the August average was down 7.1 percent or 41,920 feet per day from the 590,320 feet per day drilled during August 1959.

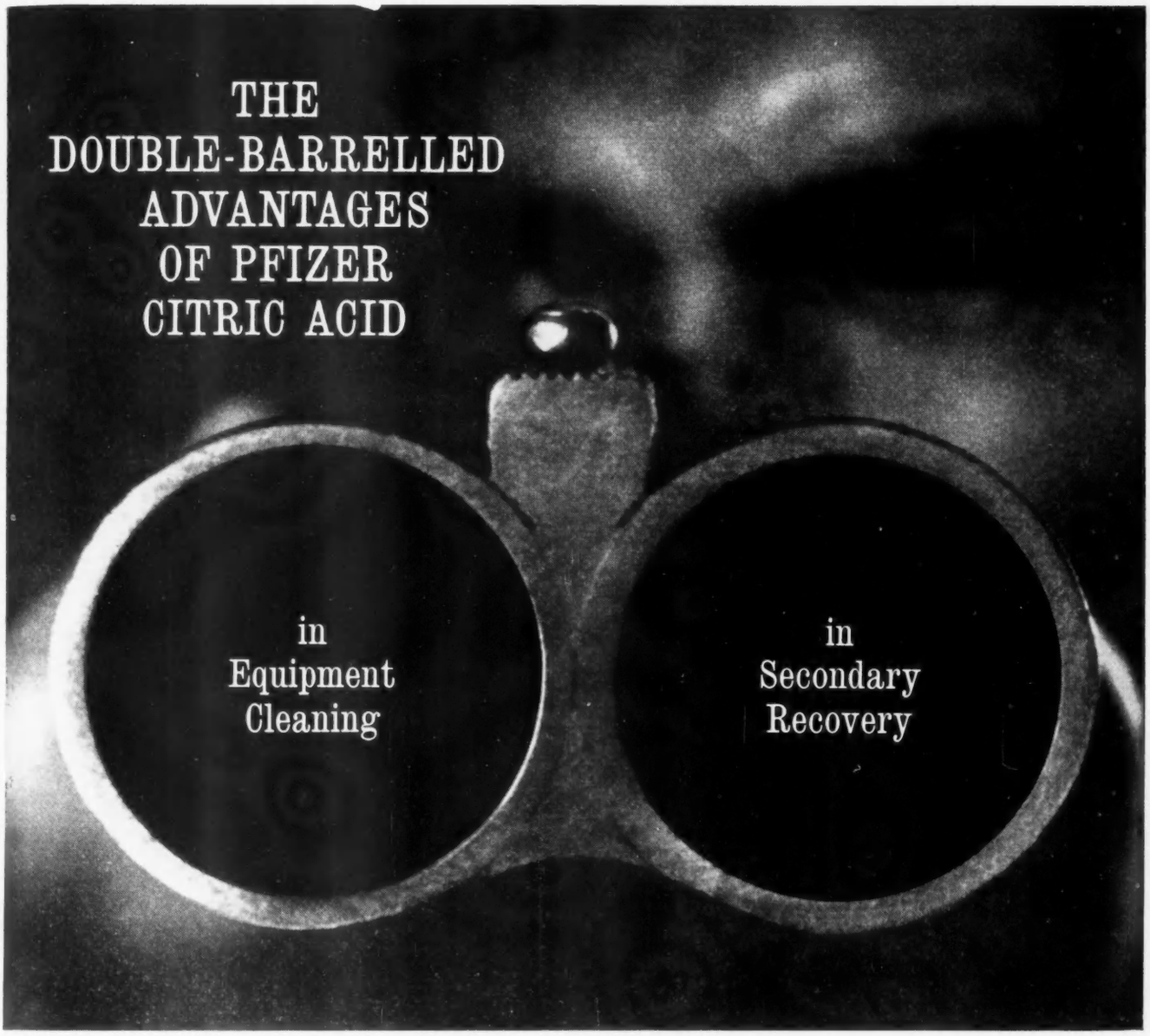
Depressed market condition continue to hold back oil well completions. During the first 8 months of 1960, operators completed 14,642 oil wells, down 14.7 percent from the same 1959 period—while gas well completions increased 4.8 percent to 12,016.

**Summary of U.S. Drilling Activity**

| ITEM | August 1960 | July 1960 | EIGHT MONTHS JANUARY-AUGUST 1960 | 1959 | % Diff. |
|---|---|---|---|---|---|
| **New Wells Completed:** | | | | | |
| Oil | 1,910 | 1,796 | 14,642 | 17,171 | —14.7 |
| Distillate | 63 | 53 | 532 | 542 | — 1.8 |
| Gas | 421 | 381 | 2,748 | 2,621 | + 4.8 |
| Dry | 1,559 | 1,566 | 12,016 | 12,184 | — 1.4 |
| Service | 126 | 101 | 744 | 754 | — 1.3 |
| **Total New Wells** | **4,079** | **3,897** | **30,682** | **33,272** | **— 7.8** |
| **Footage Drilled (Millions of Feet)** | **17.0** | **15.8** | **128.0** | **137.3** | **— 6.8** |

**Summary of U.S. Wildcat Drilling**

| ITEM | August 1960 | July 1960 | EIGHT MONTHS JANUARY-AUGUST 1960 | 1959 | % Diff. |
|---|---|---|---|---|---|
| **New Field Discoveries:** | | | | | |
| Oil | 41 | 63 | 369 | 479 | —23.0 |
| Distillate | 2 | 4 | 50 | 64 | —21.9 |
| Gas | 20 | 28 | 169 | 159 | + 6.3 |
| **Total Discoveries** | **63** | **95** | **588** | **702** | **—16.2** |
| **Dry Wildcats** | **747** | **727** | **5,546** | **5,727** | **— 3.2** |
| **Total Wildcats** | **810** | **822** | **6,134** | **6,429** | **— 4.6** |
| **(Percent Productive)** | **7.8** | **11.6** | **9.6** | **10.9** | ..... |
| **(Percent Dry)** | **92.2** | **88.4** | **90.4** | **89.1** | ..... |




●● Pfizer Citric Acid today is rapidly becoming a more useful product for the petroleum industry. Not only is it an excellent chemical cleaning agent for petroleum refining equipment, but its long established use in secondary oil recovery continues to grow.

In cleaning petroleum refining equipment, citric acid effectively dissolves scale and corrosion deposits. Citric acid also prevents the reprecipitation of dissolved scale. It will not cause chloride stress corrosion cracking. Consult your chemical cleaning service company regarding these and other advantages of cleaning equipment with Pfizer Citric Acid.

●● In secondary oil recovery, Pfizer Citric Acid prevents sandface plugging caused by iron in the injection water. The results:

- higher injection rates
- lower injection pressures
- less frequent downtime on filters
- less replacement of parts due to rusting
- reduced frequency of costly acidizing or fracturing operations

Pfizer Citric Acid sequesters iron more efficiently and economically than any other chemical. It is non-toxic, water soluble and easily handled.

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WO

# U.S. Drilling Activity in August and First Eight Months, 1960-1959

| STATE or DISTRICT | TOTAL NEW WELLS COMPLETED AND FOOTAGE DRILLED: DETAILS FOR AUGUST, 1960 — Oil | Dist. | Gas | Dry | Service Wells | TOTAL NEW WELLS — Aug. 1960 | July 1960 | Aug. 1959 | Total Footage August 1960 | DETAILS FOR JANUARY-AUGUST: NEW WELLS — 1960 | 1959 | Percent Diff. | FOOTAGE — 1960 | 1959 | WILDCAT DRILLING IN AUGUST AND FIRST EIGHT MONTHS, 1960-1959: DETAILS FOR AUGUST, 1960 — Oil | Dist. | Gas | Dry | Total Wildcats | DETAILS FOR JANUARY-AUGUST — Oil | Dist. | Gas | Dry | TOTAL WILDCATS — 1960 | 1959 | DRILLING RIGS IN OPERATION (Rigging up, Drilling, Temp. Shut-down) — Aug. 31, 1960 | July 31, 1960 | Aug. 31, 1959 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 2 | | | 1 | | 3 | 2 | 8 | 23,940 | 34 | 74 | — 54.1 | 321,825 | 658,917 | | | | 1 | 1 | | | | 5 | 5 | 23 | 5 | 8 | 8 |
| Alaska | 2 | | | | 1 | 3 | | | 25,550 | 11 | 5 | +120.0 | 121,121 | 61,887 | | | | | | 1 | | | 3 | 4 | 4 | 6 | 7 | 7 |
| Arizona | | | 4 | | | 4 | 2 | 2 | 5,021 | 19 | 15 | + 26.7 | 50,101 | 35,141 | | | | 4 | 4 | 1 | | | 16 | 17 | 14 | 6 | 7 | 14 |
| Arkansas | 20 | | 4 | 18 | | 42 | 39 | 64 | 142,574 | 377 | 528 | — 28.6 | 1,363,828 | 1,764,252 | 1 | | 1 | 10 | 12 | 2 | 1 | 3 | 80 | 86 | 79 | 32 | 35 | 49 |
| California | 68 | | 10 | 45 | 3 | 126 | 148 | 132 | 587,843 | 969 | 950 | + 2.0 | 4,424,901 | 4,561,403 | 1 | | 1 | 32 | 34 | 6 | | 7 | 186 | 199 | 191 | 108 | 117 | 135 |
| Colorado | 8 | | 3 | 35 | | 46 | 67 | 69 | 216,984 | 414 | 493 | — 16.0 | 2,124,837 | 2,591,602 | | | | 30 | 30 | 12 | | 6 | 186 | 204 | 272 | 89 | 67 | 60 |
| Illinois | 70 | | 1 | 104 | | 175 | 205 | 221 | 352,875 | 1,301 | 1,358 | — 4.2 | 2,646,432 | 3,016,335 | | | | 53 | 53 | 5 | | 1 | 428 | 434 | 312 | 248 | 249 | 289 |
| Indiana | 35 | | 5 | 89 | | 129 | 93 | 68 | 190,108 | 691 | 564 | + 22.5 | 936,060 | 906,996 | 2 | | | 34 | 36 | 4 | | | 238 | 242 | 152 | 120 | 122 | 94 |
| Kansas | 211 | | 24 | 164 | 18 | 417 | 386 | 440 | 1,482,238 | 3,288 | 3,124 | + 5.2 | 11,529,677 | 11,165,496 | 4 | | 3 | 59 | 66 | 55 | | 12 | 498 | 565 | 752 | 232 | 211 | 284 |
| Kentucky | 132 | | 25 | 93 | 1 | 251 | 248 | 429 | 183,334 | 1,918 | 2,271 | — 15.6 | 1,567,461 | 1,937,614 | | | | 9 | 9 | 6 | | 1 | 37 | 44 | 63 | 130 | 124 | 198 |
| Louisiana | 173 | 25 | 34 | 135 | | 367 | 278 | 367 | 2,888,887 | 2,203 | 2,486 | — 7.8 | 18,367,284 | 19,393,137 | 4 | | 1 | 48 | 53 | 23 | 10 | 5 | 315 | 353 | 349 | 307 | 321 | 356 |
| North Louisiana | 70 | | 19 | 49 | | 138 | 128 | 165 | 500,506 | 827 | 946 | — 12.6 | 3,141,894 | 3,366,219 | 3 | | | 19 | 22 | 10 | | 1 | 135 | 146 | 122 | 56 | 67 | 70 |
| South Louisiana | 103 | 25 | 15 | 86 | | 229 | 150 | 202 | 2,388,381 | 1,466 | 1,540 | — 4.8 | 15,225,390 | 16,026,918 | 1 | | 1 | 29 | 31 | 13 | 10 | 4 | 180 | 207 | 227 | 251 | 254 | 286 |
| *Gulf of Mexico | 22 | 3 | 3 | 16 | | 44 | 26 | 40 | 485,388 | 352 | 312 | + 12.8 | 3,637,898 | 3,213,748 | | | | 2 | 2 | | 1 | 1 | 23 | 25 | 23 | 59 | 57 | 50 |
| Michigan | 46 | | 6 | 42 | | 94 | 78 | 56 | 357,147 | 529 | 366 | + 44.5 | 1,947,376 | 1,102,630 | | | | 22 | 22 | 8 | | 2 | 137 | 147 | 91 | 119 | 134 | 97 |
| Mississippi | 23 | | 2 | 29 | | 54 | 53 | 51 | 532,813 | 464 | 420 | + 10.5 | 4,601,513 | 3,892,952 | 2 | | | 25 | 27 | 14 | | 1 | 152 | 167 | 157 | 51 | 63 | 88 |
| Missouri | | | | | | | | | | 9 | 9 | | 23,973 | 9,039 | | | | | | | | | | 7 | 1 | 1 | 3 |
| Montana | 9 | | | 17 | | 26 | 21 | 19 | 142,843 | 183 | 206 | — 11.2 | 926,550 | 988,151 | | | | 12 | 12 | 6 | | 2 | 71 | 79 | 60 | 29 | 23 | 50 |
| Nebraska | 29 | | | 72 | 1 | 102 | 109 | 74 | 570,400 | 660 | 554 | + 19.1 | 3,722,156 | 3,298,784 | 1 | | | 45 | 46 | 19 | | 1 | 268 | 288 | 246 | 27 | 43 | 41 |
| New Mexico | 88 | | 44 | 30 | 2 | 164 | 154 | 166 | 911,909 | 1,225 | 1,138 | + 7.6 | 5,985,454 | 4,719,949 | 7 | | 3 | 18 | 28 | 46 | | 30 | 182 | 258 | 173 | 150 | 136 | 159 |
| Southeast | 77 | | 5 | 22 | 2 | 106 | 103 | 93 | 608,429 | 824 | 611 | + 34.9 | 4,206,338 | 2,968,483 | 6 | | 1 | 12 | 19 | 30 | | 10 | 141 | 181 | 118 | 82 | 79 | 76 |
| Northwest | 11 | | 39 | 8 | | 58 | 51 | 73 | 303,480 | 401 | 527 | — 23.9 | 1,779,116 | 1,751,466 | 1 | | 2 | 6 | 9 | 16 | | 20 | 41 | 77 | 55 | 68 | 57 | 83 |
| New York | 16 | | 2 | 5 | 6 | 29 | 29 | 23 | 51,160 | 198 | 184 | + 7.6 | 343,685 | 316,310 | | | | | | | | | | | | 25 | 25 | 25 |
| North Dakota | 10 | | | 8 | | 18 | 27 | 30 | 98,961 | 191 | 309 | — 38.2 | 1,184,882 | 1,923,114 | 2 | | | 7 | 9 | 5 | | | 43 | 48 | 57 | 14 | 15 | 33 |
| Ohio | 37 | | 21 | 25 | 10 | 93 | 73 | 83 | 213,704 | 646 | 628 | + 2.9 | 1,557,411 | 1,703,257 | | | 1 | 3 | 4 | 2 | | 6 | 25 | 33 | 19 | 161 | 183 | 218 |
| Oklahoma | 202 | 9 | 39 | 121 | 53 | 424 | 356 | 448 | 1,479,028 | 3,035 | 3,922 | — 22.6 | 11,777,031 | 14,195,263 | 5 | | 3 | 36 | 44 | 32 | 5 | 27 | 255 | 319 | 510 | 416 | 432 | 478 |
| Pennsylvania | 25 | | 15 | 5 | 20 | 65 | 73 | 68 | 160,500 | 576 | 427 | + 34.9 | 1,584,869 | 1,355,005 | | | | | | | | 3 | 6 | 9 | 10 | 195 | 198 | 138 |
| South Dakota | | | | | | | 1 | 1 | | 16 | 10 | + 60.0 | 118,391 | 56,892 | | | | | | | | | 6 | 6 | 6 | 4 | 3 | 8 |
| Tennessee | 1 | | | 7 | | 8 | 9 | 11 | 7,841 | 56 | 83 | — 32.5 | 44,289 | 83,375 | 1 | | | 5 | 6 | 2 | | 2 | 31 | 35 | 40 | 35 | 28 | 25 |
| Texas | 615 | 29 | 111 | 448 | 9 | 1,212 | 1,256 | 1,568 | 5,469,439 | 10,167 | 11,888 | — 14.5 | 45,015,225 | 52,305,601 | 8 | 2 | 5 | 254 | 269 | 106 | 33 | 48 | 2,105 | 2,292 | 2,595 | 897 | 742 | 1,032 |
| Dist. 1: South Central | 53 | 2 | 1 | 55 | 1 | 112 | 104 | 61 | 263,627 | 705 | 646 | + 9.1 | 1,896,276 | 1,655,863 | | 1 | 1 | 36 | 38 | 3 | 1 | 2 | 218 | 224 | 219 | 41 | 28 | 37 |
| Dist. 2: Middle Gulf | 14 | 9 | 13 | 29 | | 65 | 66 | 69 | 434,314 | 522 | 534 | — 2.3 | 3,481,965 | 3,300,601 | | | | 17 | 17 | 4 | 9 | 5 | 148 | 166 | 196 | 52 | 58 | 38 |
| Dist. 3: Upper Gulf | 30 | 9 | 10 | 31 | | 80 | 125 | 115 | 606,923 | 772 | 814 | — 5.2 | 5,529,381 | 5,828,613 | | 1 | | 18 | 19 | 4 | 11 | 3 | 175 | 193 | 189 | 92 | 75 | 94 |
| *Gulf of Mexico | | | | 1 | | 1 | 1 | | 11,018 | 5 | 1 | +400.0 | 48,184 | 11,005 | | | | 1 | 1 | | | | 3 | 3 | 1 | 1 | | 2 |
| Dist. 4: Lower Gulf-S.W. | 24 | 9 | 15 | 38 | | 86 | 90 | 116 | 465,859 | 700 | 898 | — 22.1 | 3,929,489 | 4,839,848 | 1 | | 1 | 25 | 27 | 9 | 9 | 12 | 211 | 241 | 280 | 64 | 63 | 92 |
| *Gulf of Mexico | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Dist. 5: East Central | 2 | | 3 | 8 | | 13 | 21 | 11 | 70,621 | 134 | 84 | + 59.5 | 656,766 | 473,838 | | | | 4 | 4 | 2 | 1 | 3 | 71 | 77 | 43 | 22 | 22 | 13 |
| Dist. 6: Northeast | 46 | | 7 | 20 | | 73 | 84 | 86 | 387,158 | 567 | 564 | + 0.5 | 3,085,948 | 3,081,045 | 1 | | 1 | 12 | 14 | 4 | 2 | 3 | 114 | 123 | 115 | 75 | 73 | 61 |
| Dist. 7-B: North Central | 81 | | 10 | 101 | | 192 | 157 | 222 | 551,787 | 1,509 | 1,606 | — 6.0 | 4,481,921 | 5,118,312 | 1 | | | 65 | 66 | 34 | | 8 | 432 | 474 | 533 | 81 | 82 | 101 |
| Dist. 7-C: West Central | 28 | | 3 | 32 | | 63 | 60 | 73 | 228,548 | 520 | 507 | + 2.6 | 2,123,841 | 2,111,576 | | | 1 | 22 | 23 | 10 | | 5 | 141 | 156 | 163 | 75 | 59 | 65 |
| Dist. 8: West | 192 | | 12 | 60 | 3 | 267 | 244 | 375 | 1,567,512 | 2,088 | 3,063 | — 31.8 | 11,363,834 | 15,547,096 | 3 | | | 32 | 35 | 28 | | 5 | 234 | 267 | 374 | 194 | 144 | 278 |
| Dist. 9: North | 107 | | 5 | 55 | 4 | 171 | 215 | 313 | 454,884 | 1,891 | 2,375 | — 20.4 | 4,984,237 | 6,680,894 | 2 | | | 20 | 22 | 8 | | | 306 | 314 | 386 | 127 | 80 | 150 |
| Dist. 10: Panhandle | 38 | | 32 | 19 | 1 | 90 | 90 | 127 | 438,206 | 759 | 797 | — 4.8 | 3,481,567 | 3,667,915 | | | 1 | 3 | 4 | | | 2 | 55 | 57 | 97 | 74 | 58 | 103 |
| Utah | 9 | | 1 | 7 | | 17 | 19 | 7 | 97,636 | 147 | 187 | — 21.4 | 836,216 | 1,038,175 | 1 | | 1 | 5 | 7 | 2 | | 6 | 48 | 56 | 45 | 32 | 28 | 48 |
| Washington | | | | | | | | 1 | | 2 | 1 | +100.0 | 12,082 | 5,990 | | | | | | | | | 2 | 2 | 1 | 1 | 1 | 2 |
| West Virginia | 28 | | 72 | 6 | | 106 | 78 | 82 | 244,586 | 603 | 516 | + 16.9 | 1,550,740 | 1,312,985 | | | | | | | | | | | | 275 | 249 | 246 |
| Wyoming | 51 | | 1 | 47 | 2 | 101 | 93 | 90 | 521,214 | 646 | 546 | + 18.3 | 3,257,787 | 2,840,005 | 2 | | 1 | 33 | 36 | 12 | 1 | 6 | 211 | 230 | 195 | 54 | 56 | 111 |
| Others | | | 1 | 2 | | 3 | | 2 | 11,771 | 14 | 10 | + 40.0 | 73,990 | 67,068 | | | | 2 | 2 | | | | 12 | 12 | 6 | 8 | 8 | 6 |
| Total United States | 1,910 | 63 | 421 | 1,559 | 126 | 4,079 | 3,897 | 4,580 | 16,970,306 | 30,682 | 33,272 | — 7.8 | 128,017,147 | 137,307,625 | 41 | 2 | 20 | 747 | 810 | 369 | 50 | 169 | 5,546 | 6,134 | 6,429 | 3,777 | 3,636 | 4,302 |
| Total Western Canada | 180 | | 42 | 66 | | 288 | 240 | 208 | 1,706,898 | 1,703 | 1,675 | | 9,383,105 | 8,232,840 | | | | | | | | | | | | 173 | 249 | 166 |

* Gulf of Mexico wells are included in their respective district totals.

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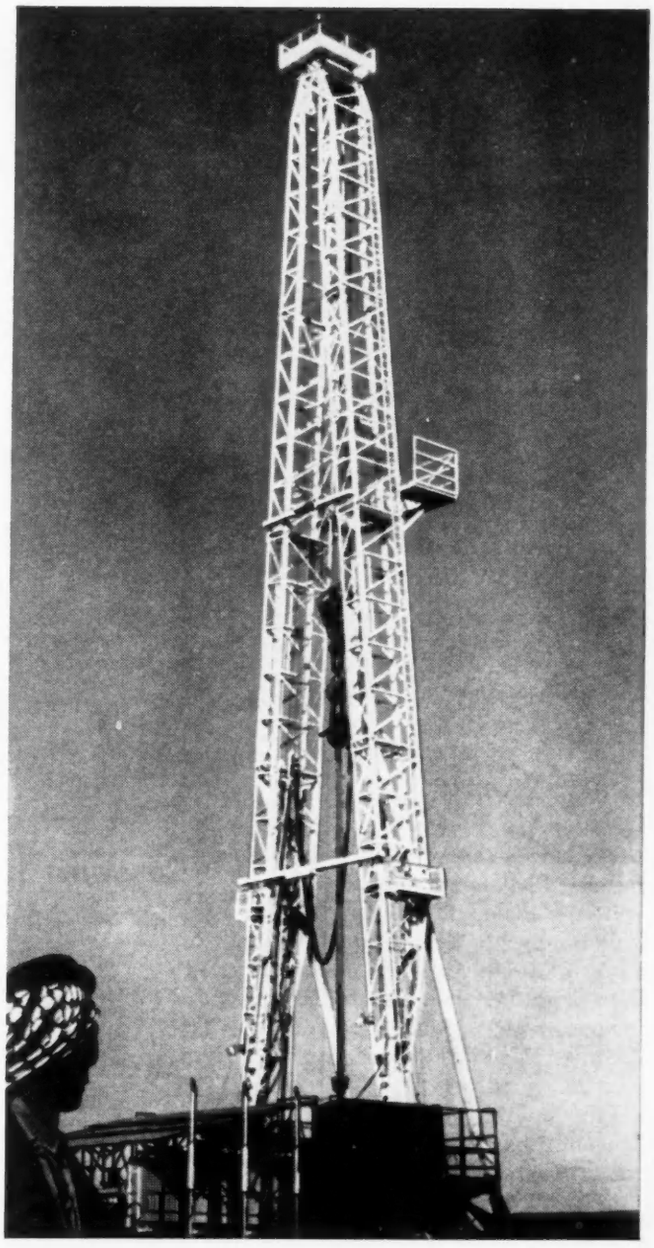

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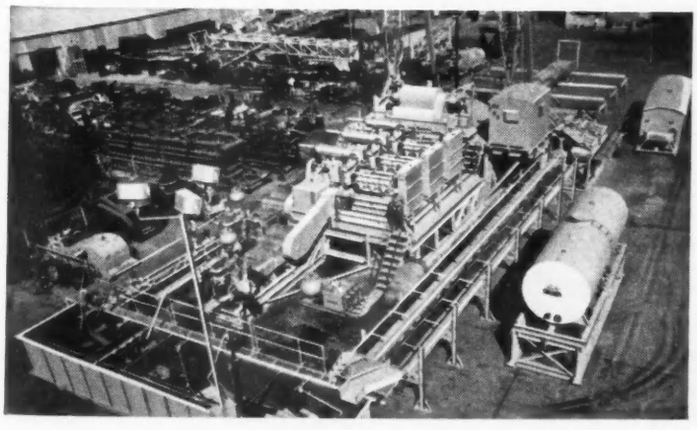

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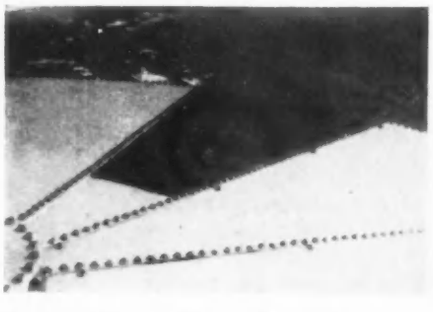
# Practical Operating Hints

## These How-To-Do-It Ideas Can Save You Money

### Store Blowout Preventer Nearby on Rig Floor

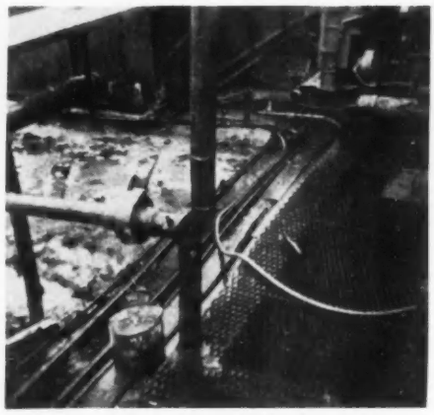
Where it is necessary to run an intermediate string of casing, a simple means of changing the blowout preventer is to unbolt the large one and pull it up through the rig floor and park it in the corner of the derrick. This saves the trouble of trying to skid it beneath the rig floor and puts it in a convenient place for loading for the next location.

On the above location, the 10-inch preventer has been raised through the rig floor and then the 6-inch picked up off of the truck from the rental yard and set back down through the same hole, where it is bolted to the top of the intermediate string of 7-inch casing.



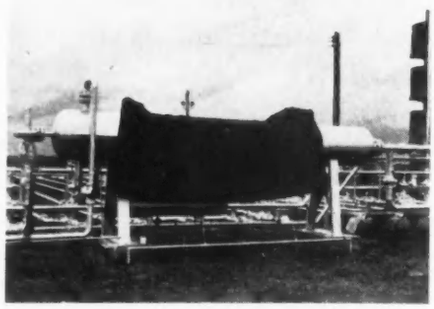
### Make Tank Top Repair With Discarded Tank Steel

An old bottom section from a discarded tank may be used to make emergency tank top repairs when necessary. About 2 inches of steel are cut off around the edges of a discarded bottom panel so it will fit between the tank bolts (on the corroded tank top section). One-quarter inch holes then are drilled around the panel and into the tank top. Sheet metal screws are used to secure the new section and regular roof cement can be used to seal it.



### Construct Support From Pipe and Metal Straps

This pipe support was built to hold the suspended line at the elbow. It is constructed from a length of the same diameter as the supported line and a set of metal straps. The support is welded to the skid holding the mud pumps. One of the metal straps is formed to fit the supported pipe and is welded to the support. The straight strap is welded to the support. The straight strap is bolted across the pipe to the curved strap.



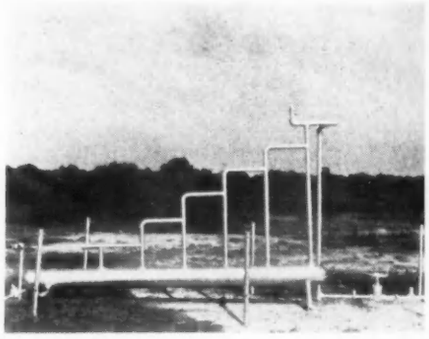
### Wind Breaker Prevents Separator From Freezing

In cold, windy weather this conventional separator frequently "iced up" and became inoperative. This operator solved the problem by installing a wind-break as shown. Heat is retained in the unit and hydrate formation is prevented.

### Let Safety Light Reduce Chances of Accidents

This entrance is adequately lighted whereby the chances of "stumbling" are minimized when entering the toolpusher trailer house.

The light is hung below the top rung of the step. The light cord is run into the trailer and plugged into a light outlet and is operated with the lighting system of the rig.

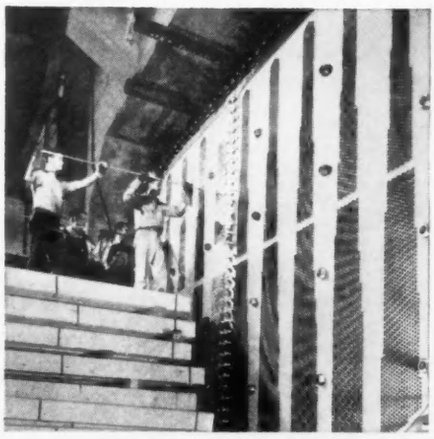


### Make An Inexpensive Separator From Scrap

This field constructed gas-liquid separator is used to remove small quantities of liquid from a gas stream.

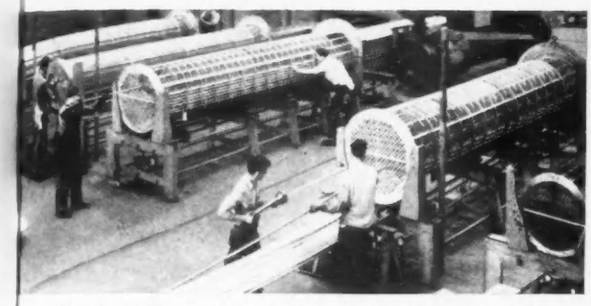
Gas and entrained liquid enter the unit on the right (see photo). The gas tends to change direction at each elbow in the piping system while entrained liquid continues in the original direction of flow. Separated liquid is collected in the volume section of the unit and is drained periodically. Connections, pipe and scrap casing are used for materials.

Alcoa Aluminum Tubing protects color in the world's largest rotary steam-tube drier. The drier measures 10 ft in diameter by 100 ft long.

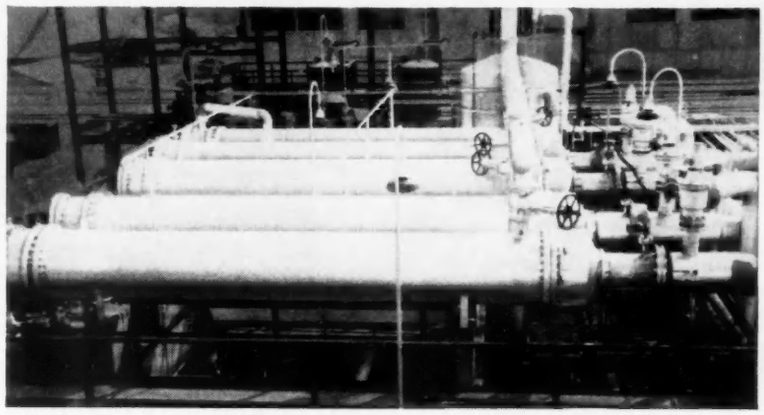


A Midwest utility saved 50 per cent on tubing costs by using Alcoa Aluminum instead of admiralty for tubing in this surface condenser. Successful operation of this unit has led to the installation of similar units by other utilities. This use demonstrates aluminum's economy and superior resistance to ammonia, carbon dioxide and hydrogen sulfide.

A battery of all-aluminum heat exchangers in a polyethylene plant. Selected for initial low cost, these aluminum exchangers provide freedom from product contamination as well as desirable low temperature properties.



Construction of a heat exchanger utilizing Alcoa Aluminum Tube. Superior working properties plus the cold-drawing method by which Alcoa seamless heat exchanger tubes are produced results in close dimensional tolerances and smooth inside and outside surfaces.



This all-aluminum dephlegmator in a large coke plant is used for the regeneration of ammonia liquor in a hydrogen sulfide scrubbing operation. Aluminum tubes lasted five times longer than steel tubes in a similar use.

## Alloy Recommendations for Aluminum Heat Exchanger Construction

| | Alcoa Designation | ASTM Specification* | Alloy |
|---|---|---|---|
| Tubes | 3003-H14 | B234 | M1A |
| | Alclad (inside) 3003-H14 | B234 | clad M1A |
| | Alclad (outside) 3003-H14 | | clad M1A |
| | Alclad (both sides) 3003-H14 | | clad M1A |
| | 6061-T6 | B234 | GS11A |
| | 6062-T6 | B234 | GS11C |
| Tube Sheets | 3004-H112 | B178 | MG11A |
| | Alclad 3004-H112 | B178 | clad MG11A |
| | 6061-T6 | B178 | GS11A |
| | Alclad 6061-T6 | B178 | clad GS11A |
| Baffles | 3003-H14 | B178 | M1A |
| | Alclad 3003-H14 | B178 | clad M1A |
| Tie Rods | 6061-T6 | B273 | GS11A |
| Shells & Headers | 3003-H112 | B178 | M1A |
| | Alclad 3003-H112 | B178 | clad M1A |
| | 3004-H112 | B178 | MG11A |
| | 5052-H112 | B178 | GR20A |
| | 5154-H112 | B178 | GR40A |
| Fittings | 3003-F | B274 | M1A as applicable |
| | 6061-T6 | B274 | GS11A as applicable |
| Flanges | 6061-T6 | B247 | GS11A as applicable |

*Only the basic number is shown since Alcoa products are manufactured to the latest issue of the specification. The complete number would indicate the year of issue.

Aluminum Company of America, 879-K Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for product transfer and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 10270 Alcoa Utilitube
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 11453 Solving Refinery Corrosion Problems with Aluminum
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 19416 Brazing Alcoa Aluminum
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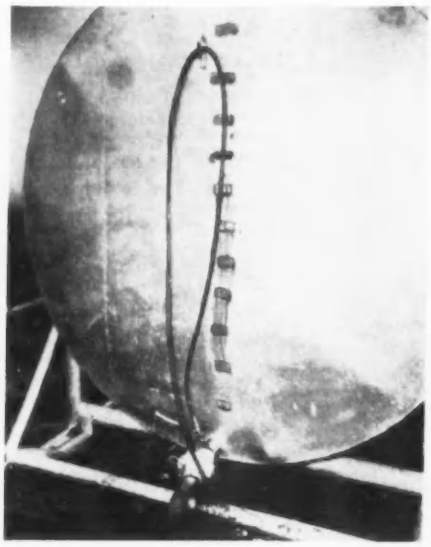


## Let Plastic Hose Serve As Sight Gage on Tank

Where it is necessary to measure certain amounts of diesel fuel into oil base mud mixes, a simple gage may be rigged up by strapping a horizontal tank and hanging up a transparent plastic hose as shown for a gage glass. The tank is strapped easily by making a mark as each load of oil is unloaded from the service tank which is accurately metered.

The gage connection is made by drilling a hole in the outlet line of the tank and threading it for a ¼-inch pipe nipple. The garden hose is then plugged onto the end of the ¼-inch pipe and swung over a hook which has been tackwelded onto the front of the tank near the top. The mud man can come by at any moment and see how many barrels of mud additive that he has in the tank.

## Use Extension to Turn Christmas Tree Valve

On many occasions, wells equipped with well guards have one or more valves which are inoperative by hand. This operator has solved the problem by installing an extension to this casing valve.

The extension is made from a length of 3-inch pipe with an L-shaped piece of rod welded perpendicularly at the end to facilitate turning. A U-shaped bracket welded from the floor frame holds the extension in place.

## Adjust Heavy Piping With Automobile Jack

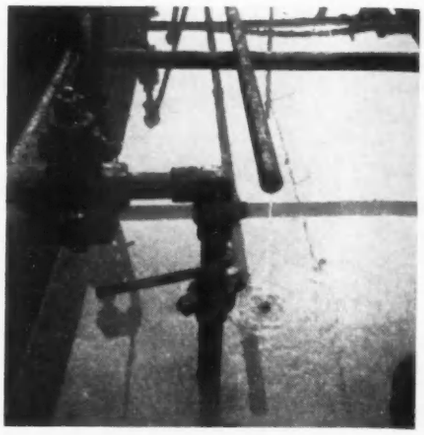
Leveling heavy pipes around a rig can result in an added effort on the drilling crews. A mechanical automobile jack is placed under the tubular line and is adjusted to the desired height.

The jack is supported with 2-inch timber and provides an excellent base in unsupported areas.



## Build Chain Container From Casing Protectors

Two 7-inch casing thread protectors and a small piece of flat steel can be used to construct a strong, relative lightweight container from the many chains used around the pulling unit. Hooks are left hanging over the side of the container so that each chain can be removed individually.



## Rotate Mud Gun To Desired Position

Quite often it is necessary to direct the flow from the mud gun. By welding a 1-inch piece of bar stock to the vertical pipe, the gun may be rotated in the swivel joint to the proper position. This rod is bent so that it is easy to reach and operate.

## Install Plastic Nipple To Check Production

In order to check production from gas lift wells more closely, this operator has installed a transparent plastic nipple on the flow line so that fluid production can actually be observed. This permits the pumper to determine accurately when a liquid slug surfaces, the duration of the slug and the duration of the tail gas flow following the slug.

Various adjustments in gas injection rates can be made and the actual production resulting from these adjustments observed, until it is apparent that an optimum rate has been selected.

# How seven drilling contractors improved their economic positions

**The ever growing cost-price squeeze means a continuing evaluation of operations. Here seven contractors tell what they are doing to maintain and improve their positions**

**Lee Daniel**
Vice President, Drilling
Helmerich & Payne, Inc.
Tulsa

To MAINTAIN AND IMPROVE its position in the drilling contracting field, Helmerich & Payne, Inc., Tulsa, has emphasized improvement in three specific areas: Men, equipment and cost control.

Men come first. Drilling is no different from any other business in that the caliber of the people doing the work determines the level of profits. To get and hold good employes, our company concentrates on improving pay, job security, fringe benefits and the challenge of new techniques. As a result, its pay scale is among the best, senior employes have preferential employment rights, a well-balanced pension plan is provided and deep drilling and other new techniques provide a continual stimulus.

Today's conditions do not warrant regular replacement of drilling machinery at the same rate permitted in times of more normal profit. The company has met this situation by experimenting with new techniques and new rig designs, and has pioneered in deep drilling (including the deepest well ever drilled by a contractor), has experimented with turbodrills, with plunger pumps, with various mud additives, with new bit designs and with a totally new type of rig using direct electric drive.

The accumulation and use of cost figures ties together the use of good equipment by good men. Helmerich & Payne, Inc.'s staff organization has concentrated on developing a system of cost controls which can rapidly and effectively point out trouble spots to management and field supervision.

To sum it all up, our company has kept its place among the leaders in the drilling industry partially by mastering new developments in the field, but mostly by pushing for a better job with the basic tools of any business man: men, equipment and cost control.

**Joe Zeppa**
President
Delta Drilling Company
Tyler, Texas

SINCE EARLY 1958, Delta Drilling Company has proceeded on the assumption that drilling activity in the U.S. would not materially improve for several years and that it would more likely worsen before it turned for the better. With this in mind, we have:

- Instituted greater controls of purchasing—*before* purchases are made—applicable from the bottom to the top. We are watching the pennies as well as the dollars.

- Made fuller use of our existing equipment and carefully scan what we have available which will fit our requirements on various rigs and areas before deciding to buy new equipment. Expenditures for new equipment must be justified on the basis of increased earnings or operating savings so as to amortize themselves in a reasonable time.

- Increased our emphasis on proper supervision over the maintenance and operation of the equipment and on the study and adoption of the most recent improvements in drilling practices. We are giving increased attention to the quality of the personnel and on their training and education.

- Continually improved our equipment through the replacement of old components with newer or more modern, with particular emphasis on greater horsepower and pump capacity to increase the rate of penetration. We have purchased and will continue to acquire modern drilling equipment which is complementary to that we own when it is available at attractive prices. We still feel that the drilling business and the drilling contractors are here to stay and we plan to keep them company.

- Placed more emphasis on the principle that when a

rig loses more money operating than idle the choice is obvious. A contractor should no longer apologize for idle rigs or worry about contracts missed to a lower price bid.

• Cooperated with our customers toward the reduction of well costs in various ways, whenever requested, including acceptance of turnkey contracts which permit us to fully control methods and procedures to our material benefit. Likewise, we have tried to contribute toward increased exploratory drilling by participating in the risk and results whenever that suited the financial plans of our customers.

• Continued our wholehearted support of and participation in the programs of the American Association of Oilwell Drilling Contractors as the only agency through which the contractors can work collectively toward the improvement of his own lot and of his services to his customers through its programs of education, training, safety, taxes, insurance, transportation, experiment and research, uniform contract and bid forms and other numerous activities on behalf of the industry as a whole.

Although there will be substantial changes and improvements in drilling equipment and methods during the next few years, it will be a long time before the present drilling equipment is substantially replaced by radically new machinery, if for no other reason than that of financial impotence.

The quality of the personnel, even more than that of the machinery, will present one of the most serious problems to be faced by the contractor in the next few years. In spite of the pressure of keen competition, he has to pay and include in his bid the increased cost of machinery and supplies, consequently, he has neglected the requirements of labor for better pay and fringe benefits in order to maintain lower operating costs.

The result has been that wages and working conditions in the drilling business have lagged far behind those in other branches of the petroleum industry, thereby continually diminishing the available supply of qualified labor. This is one phase of our operations which we seem powerless to improve, although keenly cognizant of the need of it.

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**Theodore N. Law**

President

Falcon-Seaboard Drilling Co.

Tulsa

DURING THE PAST TWO YEARS Falcon Seaboard Drilling Company has implemented some new policies which are showing desired results. Chief among these has been the sale and retirement of drilling equipment incapable of drilling to depths below 10,000 feet, and adding rigs capable of depths of 12,000 to 20,000 feet. Rigs in operation have been improved by the addition of high pressure pumps, independently driven rotating equipment and increased prime mover horsepower.

Falcon Seaboard relies not only on good equipment, but on good, experienced operating personnel. We are continually endeavoring to upgrade our drilling crews through on-the-job educational programs and have recently added two experienced drilling engineers, one on the Gulf Coast and another in the Mid-Continent area.

Falcon Seaboard has placed more emphasis on seeking overseas drilling contracts. We feel this is increasingly important in the case of contractors of our size due to the continuing decrease in the number of rigs being operated and wells drilled domestically. Also, the profit factor is not as attractive domestically as in prior years. Although there are still many problems and risks in drilling outside the U.S. not inherent in domestic work, profit is generally, more attractive.

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**B. A. Aggers**

California Drilling Manager

Santa Fe Drilling Company

Santa Fe Springs, Calif.

HOW CAN A DRILLING CONTRACTOR stay in business in today's extremely competitive market? Certainly, no problem is posed for a short-term existence in which the contractor quickly liquidates his assets by not charging sufficient overhead and depreciation.

However, the struggle to maintain an effective organization has become increasingly complex for the contractor who elects to perpetuate his company. Santa Fe Drilling Company's management and key personnel have seen California rig demand plummet from 270 active rigs in 1951 to 90 in 1960, and have witnessed the dissolution of four active contract drilling firms during the past two years.

Upgrading equipment has won the approval of customers and is largely responsible for greater drilling efficiency. Larger pumps with increased horsepower, a program of unitizing major rig components for faster moves and increased penetration by using more drill collar weight are improvements which this company has made to remain abreast of advancing competition.

Improved accounting procedures allow a closer scrutiny of drilling and operating expenses and provide a rapid method of classifying expenditures for all phases of the company's operations. Every purchase chargeable to an individual rig, well or operation is given a code number in accordance with a master accounting system. At the conclusion of every contract job, a comparison of bid estimates and actual expenses is made to provide a constant check on bidding accuracy.

Crew indoctrination in safe operating practices and blowout prevention is accomplished by demonstrations and meetings between toolpusher and crews. "Accident consciousness" is stressed by posters, safety questionnaires

and the cost of insurance to the company and each individual is emphasized.

Employe benefits have been increased and expanded to include a hospitalizaton and medical plan for employes and dependents; a vacation plan and a profit-sharing and retirement fund. Attracting and keeping qualified, high-caliber personnel has become a serious industry problem, principally because of the poor job security afforded in our increasingly competitive position.

All employes are urged to own shares of company stock. Employe ownership increases interest in company profits and stimulates maximum individual effort as an important member of the company family. This also provides an incentive for careful use of company equipment.

The acceptance of a low rate of return on invested capital and greatly-increased contract drilling risks almost needs no mention here, for this is the basic story of today's surviving drilling contractor. Santa Fe's management believes that a program of informing supervisors and crew members of today's spiraling costs and increasing contract responsibilities is mandatory for their job security and continued company success.

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**Hiram Walker**

Vice President
Meadows & Walker
Drilling Company

THERE ARE MANY THINGS, both great and small, which has made it possible for us to continue in our chosen field—the drilling business. The success of any drilling company, regardless of size, is due in a large part to furnishing the company for whom it is working with the best service possible and in a manner which the customers find satisfactory. The fact that we have maintained good personnel has certainly been an asset.

We take pride in keeping our equipment in good repair, thus enabling us to furnish the operator an efficient job, at a reasonable cost to him, while at the same time allowing us to make a fair return on money invested. We try to analyze what the drilling industry will require in the future and have purchased such items as deep well rigs, high horsepower engines and pumps. Also, to use the proper size rig for the proper depth well.

We have worked at the business and expanded if and where necessary, have kept abreast with modern drilling and operating procedures. We do not confine our operations to shallow drilling, but have leaned heavily toward deep well drilling, and have not undertaken turnkey operations to any great extent.

There has been some expressed skepticism as to just what the future holds for the drilling industry. I have great faith and very sincerely believe the drilling business will become a more stable business if good operating practices are followed.

I am very proud to have even a small part, toward helping to make the drilling industry a bigger and better business for all concerned.

**D. L. Edmiston**

President
Arrow Drilling Company
Tulsa

UP-GRADING ITS EQUIPMENT with greater pumping capacity and horsepower and re-design of rigs for lower cost in moving and rig up, has greatly contributed to Arrow Drilling Company's efforts to remain in the drilling contract business and improve its position.

Arrow Drilling realized several years ago that it was necessary to re-evaluate its position and undertake to improve its activities in all departments. One important phase has been a constant study of improved drilling practices, determining costs and exercising a strict control over purchases and inventory. These have been major factors in improving our position.

Another factor that has improved Arrow Drilling's position is its venture into fields outside the United States. The company went abroad in 1957 and operates three rigs overseas. One rig is operating in Turkey and two in Iraq. Rigs are equipped with camps for personnel, warehouses and all equipment to make them self-sufficient.

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**Jack H. Abernathy**

Vice President
Big Chief Drilling Company
Oklahoma, City

DURING THE PAST YEAR OR SO, Big Chief Drilling Company has improved its position in the drilling contract business by adopting the following policies:

1. Tightened procurement procedures and inventory control methods to be more nearly certain that when an item is purchased it is:

A. Not already available in our stocks somewhere, and

B. It is bought at the best price for which the item can possibly be obtained.

2. Sales efforts have been intensified.

3. Several rigs have been added without adding overhead, thus tending to reduce costs. —**The End**

# What's the future of big-hole drilling?

**Will big-hole drilling offer an outlet for the economic pressure currently confronting the drilling contractor?**

**Because this field of endeavor is in its infancy and its potential is difficult to evaluate, WORLD OIL's staff obtained the following interviews from representatives of the three drilling industry phases concerned directly with the future of big-hole drilling.**

## Larger and deeper holes predicted

### Big-hole drilling limited only by the resourcefulness and ingenuity of the contractors

**By C. R. Woodruff,** Field Manager, Terminal Drilling and Production Company, Wilmington, Calif.

ITS FUTURE ASSURED, big-hole drilling is limited only by the ingenuity and resourcefulness of drilling contractors who, heretofore, may have felt their income was limited only to drilling conventional oil wells. Not only will there be more and more big hole jobs, but the sizes of holes doubtlessly will increase rapidly. Whereas, a few years ago, "big-hole" meant perhaps 18 to 26-inch hole, it is apparent that holes of from 36 to 60-inch size are becoming commonplace.

C. R. Woodruff

Terminal Drilling and Production Co. has gained considerable experience during the past 10 years in the drilling of large diameter "specialty" holes. Designing and building the special tools and equipment necessary to handle very large bits, hole openers, casing, together with the modified sub-bases and rigs required in the drilling of large diameter holes, has been a necessary part of this work.

Principal factors that must be considered in designing and building specialty hole drilling equipment are, in the order of their importance:

- **Circulation.** The larger the hole, the more of a problem it becomes to maintain sufficient rising velocity to remove cuttings. For this reason, reverse circulation becomes essential in many instances.
- **Bit design.** Factors involved here are not only the cutting ability, but a design which will allow fast cutter replacement, good stability and simple maintenance.
- **Drill collar weight.** A stable drill collar that provides the necessary weight and which allows maximum ease of handling is necessary.
- **Handling tools.** It is in this field that imagination and ingenuity are necessary to fabricate or modify existing equipment that will handle the very large drilling tools and casing.

The following brief list of specialty holes, drilled by Terminal Drilling during the past 10 years, illustrates the

wide variety of jobs and hole sizes that typically fall in this category:

- Air drilling of 20-inch hole in hard sandstone to anchor a missile engine test stand used for experimentation.

- The drilling of over 200 "freeze holes" on a dam site project. Holes of 12¼-inch diameter were drilled in the river bottom through granite boulders. The holes were cased, then refrigerated to form a sub-surface ice dam.

- Drilling more than 300 holes ranging in diameter from 26 to 36-inches as deep as 2,400 feet, for earthquake and formation subsidence control in the Wilmington, Calif., oil field. Such holes, packed with a special gel type fluid to hold the hole open around the pipe, allow movement of formations without damaging casing.

- Drilling the first series of large test holes for the government in 1957. These holes ranged in depth to 500 feet, with 42-inch hole being drilled to 250 feet and with 36-inch hole being drilled from there to total depth. Thirty-inch casing was run in these holes.

- The drilling of two mine ventilation shaft holes in the Ambrosia Lake Mining District near Grants, N. M., in which two 46-inch holes were drilled and cased with 36-inch casing; one to a depth of 930 feet and the other to 1,432 feet.[1]

**Sub-base modifications.** Aside from the necessity of designing special equipment and techniques, there still remains the costly problem of modifying and building sub-bases which will accommodate the king-size bits and casing and support the tremendous weights involved. The 36-inch casing used on the above 46-inch hole job in New Mexico, for example, had wall thicknesses ranging from 5/8-inch up to 1 inch and weighed from 236 pounds to as high as 373 pounds per foot.

It readily can be seen that a substantial investment rapidly can be built up in specialty hole tools such as elevators, spiders, slips and bits, much of which might be used on just the one job. Then, too, there are such "minor" modifications as, for example, the rigging of a drawer-like box which is inserted through a mud-tight door in the side of the surface pipe below derrick floor level, the purpose being to support bits and reamers when they are broken out. A specially-designed centralizer-equipped tubing string, to speed swabbing mud from the completed and cased hole, is another example of the type of equipment that must be devised to solve the "routine" problems which arise in big-hole work.

**New rig to drill 8-foot hole.** Hole sizes steadily will increase as time goes on and, to handle such work, Terminal Drilling has designed and started to build a rig capable of drilling 8-foot hole to depths of from 2,500 to 3,000 feet. The design of this rig contemplates the use of 10¾-inch drill pipe weighing about 50 pounds per foot, equipped with specially-designed tool joints. The derrick also would be of special design. Reversed circulation will be used in order to obtain sufficient rising velocity of from 8 to 15 feet per second, when drilling with water. In many instances, of course, it becomes necessary to mud up in a hole if special problems arise.

Such a rig, it is contemplated, should be able to drill at rates up to as high as 30 feet per hour in soft formations. It would be used in the drilling of mine shafts, air vent holes and for various other minning and tunnel projects.

Although this rig will cut holes of a size heretofore seldom contemplated by an oil well drilling contractor, plans already are being made, and the equipment now is in the design stage, for a rig capable of drilling specialty holes up to 15 feet in diameter and to depths of approximately 100 feet. Information on the 15-foot diameter holes is of a classified nature and cannot be released, but it readily can be seen that yesterday's "big hole" is not necessarily the "big hole" of tomorrow.

Terminal's experience to date indicates that rotary drilling of large diameter holes, while a specialized technique all its own, on an increasing scale will be specified in many mining, construction, tunnel and other industrial projects. In fact, rotary drilling, ultimately, probably will take over most shaft-sinking in mining operations. Total cost to the customer usually will be less than hand-dug shafts. Tool rotary-drilled holes ordinarily can be drilled and completed in much less time. It is the author's considered opinion that drilling contractors more and more will be called upon to drill "specialty" holes of this type.

LITERATURE CITED

[1] Wilson, Gilbert M., "Standard Rig Used to Drill 46-inch Holes," World Oil, February 1, 1960.

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# Better techniques, equipment needed

## Technological advances would open new markets to air drillers

**By Robert Sneed,** Vice President,
Well Completions, Inc., Denver

Present available air drilling knowledge can take the fullest advantage of the present and potential big hole markets. The present markets and customers are relatively few. Many more markets can be opened by combining the "far out" approach of the visionary with the hard pencil pushing of the engineer.

Robert Sneed

Holes larger than 15 inches in diameter have been drilled for relatively few customers, primarily those in the mining industry, governmental agencies and water well drilling. Unless significant advances are made in drilling "big holes"—meaning five feet or more in diameter—this market will remain con-

stant in size and fluctuate in quantity of available work, for the drilling industry.

This market potential appears, at the present time, to be insufficient for the development of the tools and techniques which create evolutionary expansion into other markets. There is an unfortunate tendency to build "monsters" for big-hole drilling. Standard equipment is merely built on grander, larger, heavier scale, rather than employing engineering creativity in a fresh approach. One need only to consider that a five-foot diameter hole has 25 times at volume of a similar hole one foot in diameter; the hydraulics of the liquid circulating system alone call for a re-examination of big-hole drilling in conventional rotary drilling terms.

Our approach is naturally to consider all drilling in terms of what air has done and what it might be made to do. Our problem, too, is the economics of developing the engineered equipment to take advantage of a limited market. Our first thoughts are how to create new markets to amortize development costs more rapidly while drilling big holes for the few customers initially.

If drilling contractors, manufacturers and others could work together, more could be done than is now thought feasible.

Consider, for example, a hole that is 10 feet in diameter and 300 feet deep. It has been drilled and faced with concrete and this sprayed with an inert plastic, reducing the diameter to 9 feet ID. In terms of dry storage, such a hole would contain 19,075 cubic feet or a little over 15,000 standard bushels. In terms of liquid storage, the hole-vessel would contain 3,400 barrels of 42 gallons each. These contents would require above ground storage in a tank 40-feet in diameter and 15 feet high.

By considering a hole in the ground in terms of bushels and barrels we change the economic significance of the "big hole" challenge. Costs of drilling and lining now must compete with tank construction. In our favor, however, is the ever-rising cost of real estate in urban and urbanizing areas. This may alleviate somewhat the other cost factors of changed materials handling and maintenance methods for underground tankage and silos.

If we consider a hole 300 feet deep, only 20 feet in diameter and lined as before, this would give us a dry storage capacity of about 68,500 bushels or liquid storage of some 635,000 gallons of water. More important, we would now have the equivalent of a 30-story building underground. Our next step is to tangentially drill a 10-foot hole to be utilized as an elevator shaft to service the various levels of our subterranean building. Now what? Underground warehousing? Constant temperature storage? Power generating locations? Controlled climate manufacturing processes?

Air drilling, it is believed, will have a definite place in "big-hole" drilling, but vertical boring needs more customers than now exist. To get these customers, developing drilling techniques and equipment for their purposes, a hole in the ground must be considered as having a higher utility value than merely allowing fluid access from a certain depth up to the surface.

# Rotary equipment undergoing change

## Increasing big-hole success should prompt new ideas and designs

**By H. G. Bentson,** Chief Field Engineer,
Smith Tool Company,
Compton, Cailf.

THE INCREASING SUCCESS with which extra large diameter holes (36-inch and larger) have been drilled in the last two years by rotary methods has resulted in the availability of a variety of new or modernized drilling bits and related equipment.

H. G. Bentson

Currently, there are several variations in the type of drilling bits available. Construction of these tools vary considerably, although most utilize rotating type cutters which are similar in principle and comparable in performance to those used on standard types of large rotary rock bits. Among the most widely used drilling tools are those commonly referred to as reaming bits or hole openers and cluster or plate type bits.

The reaming bit or hole opener shown in Figure 1 usually consists of three or four field replaceable roller type cutters mounted on a specially designed integral body and a pilot attached to the lower end of the body to center the tool in relation to the pilot hole. Tool joint connections generally are used on these tools; however, flanged or other types can be furnished on special order. Cleaning of the cutters is accomplished by means of circulation ports in the body which direct the fluid on the cutter teeth.

The addition of jet circulation, a recent significant improvement, insures the rapid removal of cuttings from the formation shelf which in turn is essential for optimum performance. Replaceable flow nozzles, featured on the jet type tools, permit adjustment of the nozzle size to satisfy specific circulation conditions. Hole openers and reaming bits are used to ream the hole from pilot hole to full diameter in progressive stages or steps, and are preferred by many operators inasmuch as a large investment in special equipment and abnormal bit weights are not required for their operation.

The cluster or plate type bit consists basically of a fabricated body on which a multiplicity of roller type rock bit cutters are individually mounted. Design of this

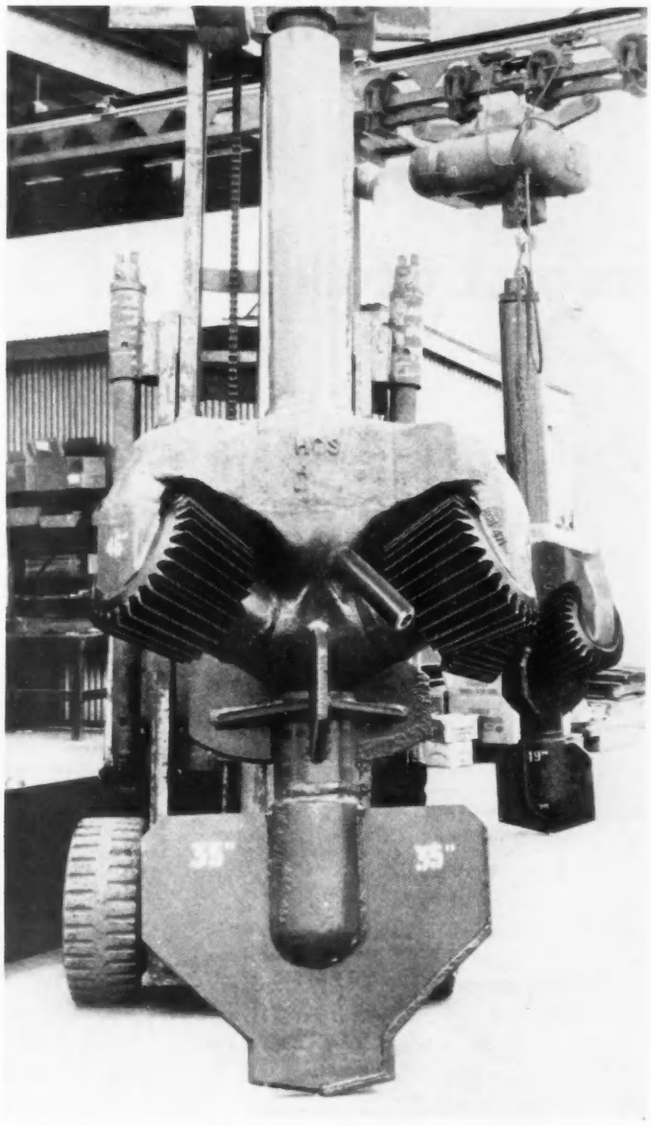


FIGURE 1—Hole opener for use in a 46-inch hole.

type of tool ranges from those built in a welding shop using cutters and legs cut from regular 3-cutter bits and welded to a home-made body to those engineered and built by established manufacturers using specially designed field replaceable cutters and legs scientifically located and bolted on a pre-fabricated body.

Flanged connections appear to be the most widely used on these types to facilitate handling. Cleaning of the cutters and hole is achieved by means of circulation ports which direct the fluid on the cutters or by jet tubes which direct the fluid on the formation in a manner similar to the jets on a jet rock bit. Tools of this type generally are used to ream the large diameter hole from the pilot hole to full diameter in one pass, although some designs permit the reaming to be done in progressive steps.

Additional variations in the design of drilling bits are also possible, using individual cutter-leg assemblies. These units, which may be bolted or welded onto fabricated bodies or frames, permit construction of a variety of non-standard drilling tools offering arrangements desired for special applications without any, as yet, defined hole diameter limitation. Designs of this type are under consideration at this time.

The efficiency of rotary drilling of large diameter holes has been further improved by the rapidly increasing availability of other additional or improved items of equipment. Large reamer-stabilizers have now been built to reduce vibration and to provide desirable stabilization of the drill string. Extra large diameter drill collars can be used to satisfy the "weight without excessive length" requirements of the cluster or plate-type bits. Large casing shoes, handling equipment and other items are no longer considered strictly special. Rotary drilling rigs especially designed for large hole drilling are being or have been constructed.

The relative degree of success attained by rotary methods thus far should bring forth many new ideas for it appears that the industry has not settled on any specific techniques or tool designs. With the demand for large holes increasing and the future of the rotary method assured, it is reasonable to expect that the development of new tools and improved techniques will be continued.

**—The End**

# How to forecast accurate drilling costs

## Footage price of most contractors is directly related to the set drilling time and number of bits

**By O. E. Mecham,** Vice President
**M. S. Legge,** Assistant Manager
Drilling Analysis Service Company
Denver

DRILLING CONTRACTORS are finding it imperative to determine with the greatest accuracy possible cost factors on which drilling bids will be based. And oil operators must depend upon these basic drilling cost figures to correctly estimate the expenditures necessary for proposed test wells so they can weigh cost against the economic attractiveness of the ventures. The accuracy of forecasting well costs also has an important bearing on annual exploration and development budget programs. Oil industry economics now demand that budget dollars be stretched to drill the maximum number of wells possible in the search for and development of oil reserves.

**Footage cost considerations.** Some 65-75 percent of the drilling contractors' footage price for an average exploratory well is directly related to "variable" cost, composed of net drilling time and drilling bits. The remaining cost items may be classified as "fixed," and they represent those operations whose cost of which can be predetermined with reasonable accuracy. These costs are:

- Moving rig to location.
- Rigging up and tearing out.
- Drilling contract requirements involving WOC time.
- Cumulative lost circulation time.
- Special equipment rental and possibly water or mud.

Figure 1 indicates the relative amounts of "variable" and "fixed" costs incorporated in footage prices.

Variable and fixed costs, augmented by rig and drill string depreciation, overhead and profit figures form the basis of the footage price. Considering the small percentage of the footage price in this competitive period represented by these latter factors of depreciation, overhead and profit, the need for accuracy in determining net drilling time and bits becomes apparent. Today, there is little room, if any, for a cushion or contingency factor in these determinations. To err on the high side is tantamount to losing the bid; to err on the low side is to invite almost certain dollar losses.

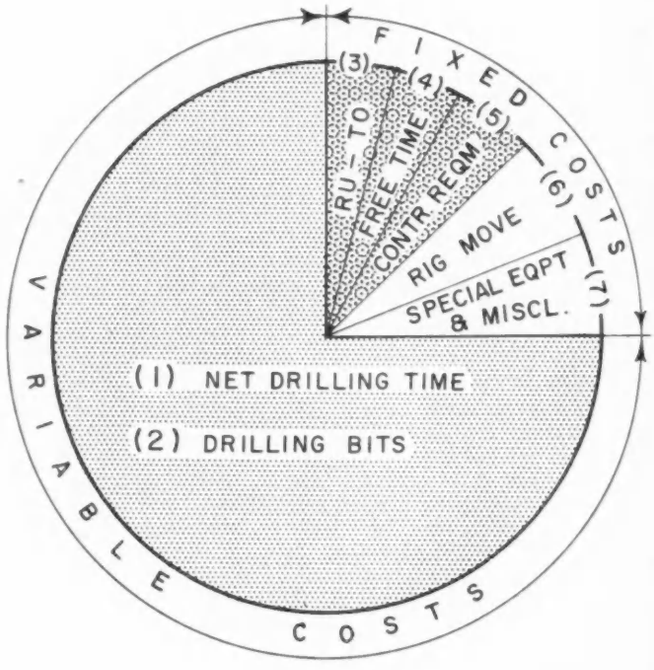



**FIGURE 1—Relative proporations of items comprising drilling contractors "Fixed and Variable" costs included in footage price for an average exploratory well.**

**Accurate forecasting method.** Under the profile method of estimating drilling penetration rates and drilling bit requirements, experience has shown that net drilling days and bits can be forecast consistently with an accuracy of 95 percent to 97 percent where normal drilling conditions are involved. When drilling a well, steeply dipping formations, severe faulting conditions or extended lost circulation problems present factors which tend to

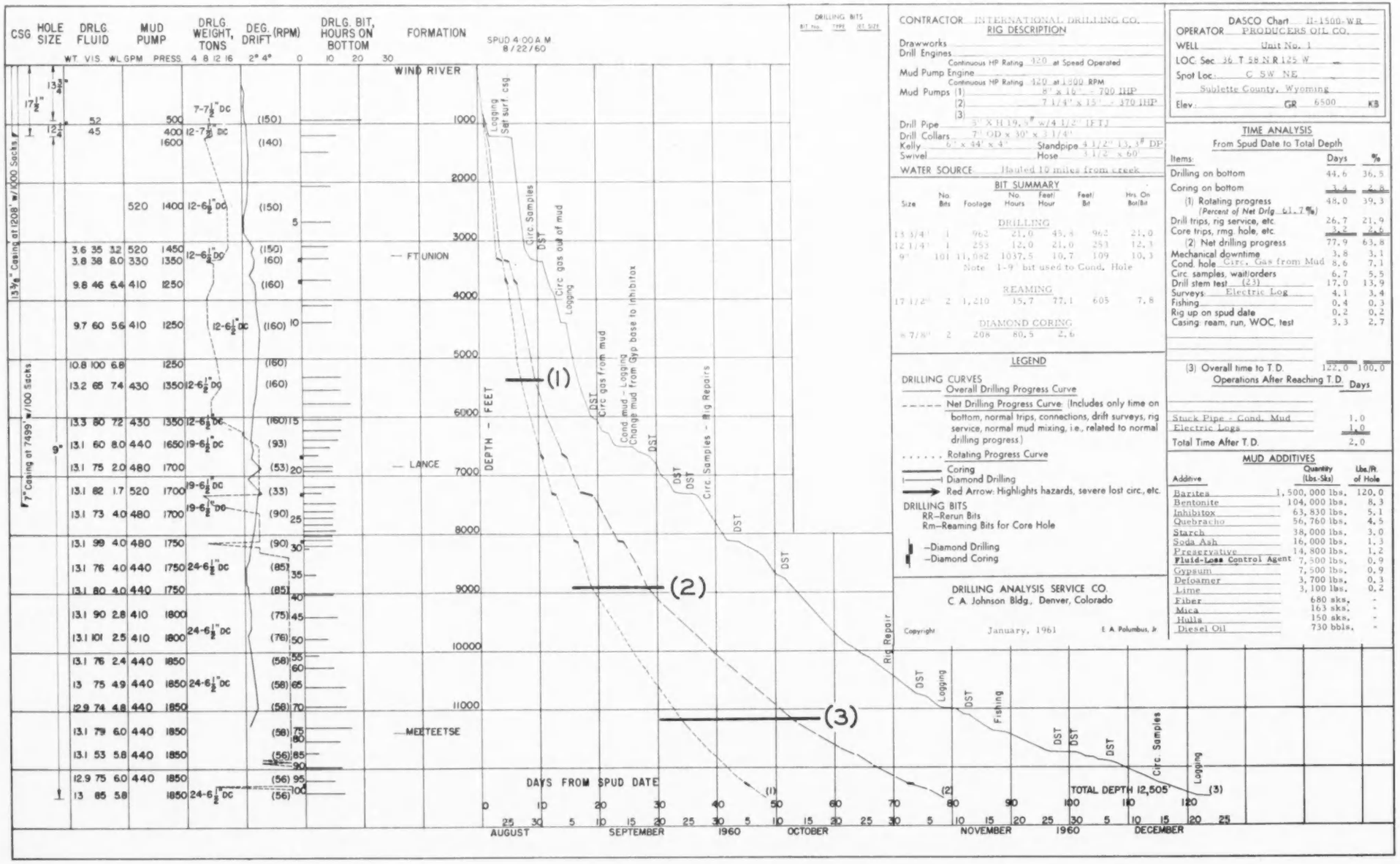

CONTRACTOR INTERNATIONAL DRILLING CO.
RIG DESCRIPTION
Drawworks
Drill Engines
Continuous HP Rating 420 at Speed Operated
Mud Pump Engine
Continuous HP Rating 420 at 1800 RPM
Mud Pumps (1) 8" x 16" - 700 IHP
(2) 7 1/4" x 15" - 470 IHP
(3)
Drill Pipe 5" X H 19.5# w/4 1/2" IFTJ
Drill Collars 7" OD x 30' x 3 1/4"
Kelly 6" x 44' x 4" Square Standpipe 4 1/2" 13.3# DP
Swivel Hose 3 1/2" x 60'
WATER SOURCE Hauled 10 miles from creek
DASCO Chart H-1500-WR
OPERATOR PRODUCERS OIL CO.
WELL Unit No. 1
LOC. Sec. 36 T 58 N R 125 W
Spot Loc. C SW NE
Sublette County, Wyoming
Elev. GR 6500 KB
BIT SUMMARY
Size | No. Bits | Footage | No. Hours | Feet/ Hour | Feet/ Bit | Hrs. On Bot/Bit
DRILLING
13 3/4" 1 962 21.0 45.4 962 21.0
12 1/4" 1 255 12.0 21.0 253 12.3
9" 101 11,082 1037.5 10.7 109 10.3
Note 1-9" bit used to Cond. Hole
REAMING
17 1/2" 2 1,210 15.7 77.1 605 7.8
DIAMOND CORING
8 7/8" 2 208 80.5 2.6
TIME ANALYSIS
From Spud Date to Total Depth
Items: Days %
Drilling on bottom 44.6 36.5
Coring on bottom 3.4 2.8
(1) Rotating progress 48.0 39.3
(Percent of Net Drlg 61.7%)
Drill trips, rig service, etc. 26.7 21.9
Core trips, rmg. hole, etc. 3.2 2.6
(2) Net drilling progress 77.9 63.8
Mechanical downtime 3.8 3.1
Cond. hole Circ. Gas from Mud 8.6 7.1
Circ. samples, wait/orders 6.7 5.5
Drill stem test (23) 17.0 13.9
Surveys Electric Log 4.1 3.4
Fishing 0.4 0.3
Rig up on spud date 0.2 0.2
Casing: ream, run, WOC, test 3.3 2.7
(3) Overall time to T.D. 122.0 100.0
Operations After Reaching T.D. Days
Stuck Pipe - Cond. Mud 1.0
Electric Logs 1.0
Total Time After T.D. 2.0
LEGEND
DRILLING CURVES
Overall Drilling Progress Curve
Net Drilling Progress Curve (Includes only time on bottom, normal trips, connections, drift surveys, rig service, normal mud mixing, i.e., related to normal drilling progress.)
Rotating Progress Curve
Coring
Diamond Drilling
Red Arrow: Highlights hazards, severe lost circ., etc.
DRILLING BITS
RR—Rerun Bits
Rm—Reaming Bits for Core Hole
—Diamond Drilling
—Diamond Coring
MUD ADDITIVES
Additive Quantity (Lbs.-Sks) Lbs./Ft. of Hole
Barites 1,500,000 lbs. 120.0
Bentonite 104,000 lbs. 8.3
Inhibitox 63,830 lbs. 5.1
Quebracho 56,760 lbs. 4.5
Starch 38,000 lbs. 3.0
Soda Ash 16,000 lbs. 1.3
Preservative 14,800 lbs. 1.2
Fluid-Loss Control Agent 7,500 lbs. 0.9
Gypsum 7,500 lbs. 0.9
Defoamer 3,700 lbs. 0.3
Lime 3,100 lbs. 0.2
Fiber 680 sks. -
Mica 163 sks. -
Hulls 150 sks. -
Diesel Oil 730 bbls. -
DRILLING ANALYSIS SERVICE CO.
C. A. Johnson Bldg., Denver, Colorado
Copyright January, 1961 E. A. Polumbus, Jr.
CSG HOLE SIZE DRLG FLUID WT VIS WL MUD PUMP GPM PRESS DRLG WEIGHT, TONS 4 8 12 16 DEG. DRIFT (RPM) 2° 4° 0 DRLG. BIT, HOURS ON BOTTOM 10 20 30 FORMATION
SPUD 4:00 A.M. 8/22/60
WIND RIVER
— FT. UNION
— LANCE
— MEETEETSE
13 3/8" Casing at 1208' w/ 1000 Sacks
7" Casing at 7499' w/ 100 Sacks
DEPTH - FEET
DAYS FROM SPUD DATE
TOTAL DEPTH 12,505'
AUGUST SEPTEMBER 1960 OCTOBER NOVEMBER 1960 DECEMBER
(1) (2) (3)
Logging
Set surf csg
Circ. Samples
DST
Circ gas out of mud
Circ gas from mud
Cond. mud - Logging
Change mud from dyp base to Inhibitox
Circ. Samples - Rig Repairs
Rig Repair
Fishing

FIGURE 2—Typical drilling analysis chart used in well profile method of forecasting net drilling days and bits.

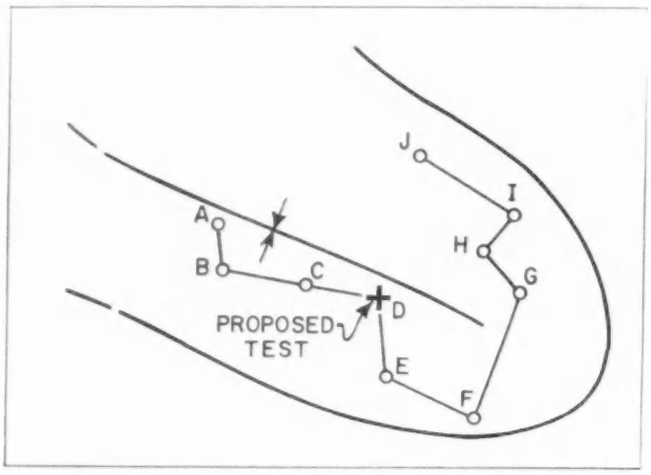



FIGURE 3—In forecasting drilling time and bit requirements for a proposed test well, the first step involves selection of drilling analysis charts to supply basic data for construction of a well profile.

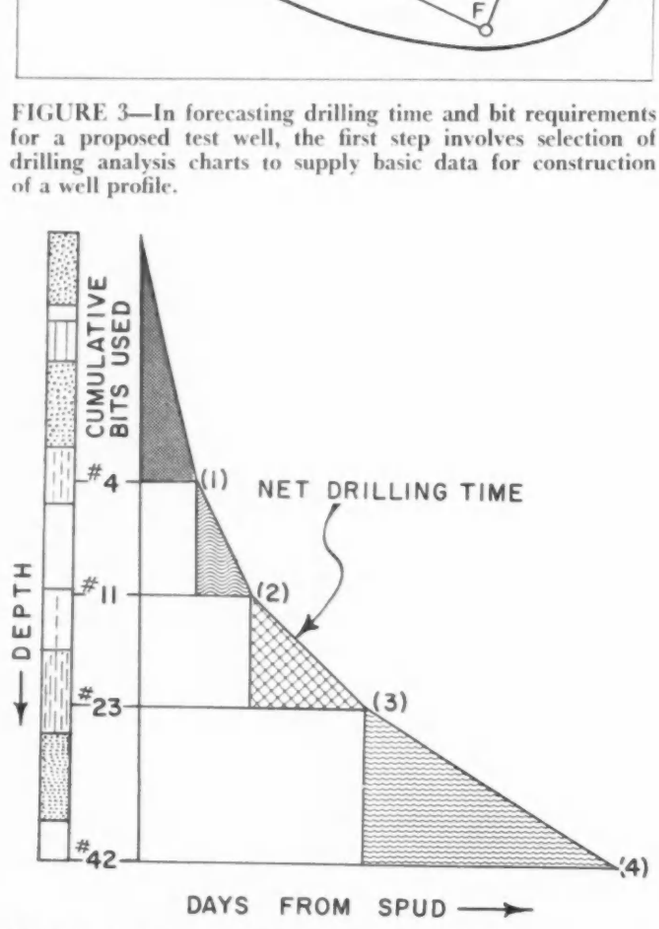



FIGURE 4—The net drilling time curve is divided into increments having a different straight line penetration slopes.

reduce the accuracy of time and bit estimates regardless of the estimating method employed. Where such abnormal conditions are known to exist when the time and bit study is being prepared, the profile method has been found to provide acceptably accurate results, even in complex cases of faulting, overthrusting or steep dips.

**Use of drilling analysis charts.** The profile method makes use of drilling charts which provide the basic data in a convenient, condensed, time-saving form. Figure 2 shows a typical drilling analysis chart.

The three drilling penetration curves included on each chart show:

1. Over-all drilling progress
2. Net drilling progress
3. Rotating progress.

The over-all drilling progress curve reflects the daily over-all progress of the well and includes descriptive information highlighting those operations affecting advancement. The net drilling progress curve includes only time on bottom, normal trips, connections, drift surveys, rig service, normal mud mixing, i.e., only those items related to normal drilling. It represents, therefore, a drilling curve from which variations in program between one well and another have been removed such as drill stem testing, electric logging, lost circulation, fishing operations, etc. The net drilling progress curve thus provides a medium by which pure drilling progress can be compared between wells.

The rotating progress curve represents the cumulative rotating on bottom time and is especially useful in engineered drilling studies.

The drilling charts also include information on casing and hole size, mud properties, pump pressure and mud volumes, drilling weights, rotation speed, hole deviation from vertical, formation marker tops, drilling bit details (type, hours and depth run, nozzle sizes) and rig equipment details necessary for hydraulics calculations.

The statistical summary presents a time analysis of the component operations comprising the entire project from spud to rig release. A drilling bit, reaming and coring summary, plus a tabulation of the total amount of each mud additive used, complete the chart.

**Selecting wells for study.** Drilling penetration rates and drilling bit footage may be said to vary in two component directions—horizontally and vertically. Assume, for example, that a specific formation is uniformly present in the general area under study and occurs at approximately the same depth below the surface. Drilling penetration rates and bit footage may exhibit uniformity throughout the area; conversely, these factors may be found to vary in one specific direction showing either increasing or decreasing values due to lateral changes in sedimentation, degree of cementation, and to induration or hardening of the strata, resulting from compression of the beds due to folding.

Penetration rates and bit footage in the same formation generally are more sensitive to depth changes and reflect a progressive hardening with depth due in large measure to compaction.

The profile method of forecasting drilling penetration rates and bit footage permits the determination of the horizontal and vertical variations in these rates in the area under study. A prevalent misconception exists that reliable estimates can only be achieved by the use of primarily "offset well" records. Proper application has proved that charted wells can be used in the study involving locations as far as 50 to 75 miles from the test site.

Figure 3 represents an ideal location selection of drilling charts for the profile study. This is based upon utilizing charted wells located in all directions from the test site and that are also both up dip and down dip. It may be found desirable to augment control available from charted wells by bit records of some key unchartered wells in the immediate vicinity of the proposed test.

**Selecting depth intervals for study.** During the past nine years, drilling records have been reviewed and drilling analysis charts of more than 1,400 wells constituting in excess of 11.0 million feet of hole drilled in various

geologic provinces of North America, South America, North Africa and the Near East. As can be observed in Figure 2 and idealized in Figure 4 a noticeable characteristic of drilling penetration rates in nearly all areas is that the net drilling and rotating progress curves do not form smooth curves, but consist of a series of essentially straight-line penetration slopes at various angles.

The changes in slope may occur at the contacts between different rock units, or the changes may occur at any point in the section, irrespective of the geological formation. These points of change may not be identical in all wells drilled throughout an entire sedimentary basin. In an area selected for the study, it usually is possible, however, to establish correlative points of change for each charted well placed on the profile.

**The well profile.** After selecting the slope change points for each well a well profile (Figure 5) is prepared and the four—1, 2, 3 and 4—comparable points are connected. Reference to Figure 4 shows that it is possible to deal with short depth increments, for each of which the weighted average feet per day and feet per bit can be determined. Actually this is equivalent to studying the penetration and bit performance for each small triangle shown in Figure 4. This employs the same principle to attain greater accuracy that calculus achieves in integrating an area under a curve by dividing the area into an infinite number of parts.

After determining the feet per day and feet per bit for each interval in wells studies, weighted average values are next placed on the profile (Figure 5) and also shown at each well location in Figure 3. This permits an examination of the relative effects of regional and depth influences on penetration rates and bit footage. When the profile includes wells located in all directions from the proposed test location, it generally suffices to establish the relationship of depth vs penetration rate and bit footage.

**Depth influence on penetration rate and bits.** Figure 6 presents a method for determining the relationship of feet per day and feet per bit versus depth for each of the four increments shown in Figure 5. The valves of weighted penetration rate and bit footage previously determined are plotted (Figure 6) for each well at a depth representing the base of the specific increment. This permits the delineation of maximum and minimum limits for the wells studies.

The next step is to examine the details provided on the drilling analysis charts concerning rig capacities, hydraulics and drilling technique employed, and the presence or absence of special problems such as crooked hole or lost circulation. The contractor or operator making the study can weigh these factors against the capacity and efficiency of the rig to be employed and the techniques that will be followed. It is then possible to place an estimated "performance curve" on the graphs for each increment as illustrated in Figure 6.

The anticipated base of the specific increment then is added on each graph. These depths are selected with the aid of subsurface geologic marker points provided for the test well. The intersection of this horizontal "base" line with the estimated performance curve determines the penetration rate (and bit footage) that should be attained by the rig under consideration.

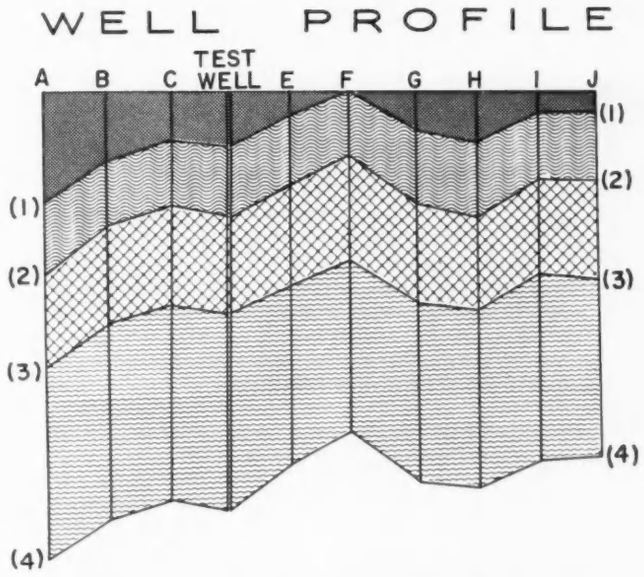



FIGURE 5—Comparable slope change points in penetration rates are connected on the well profile.

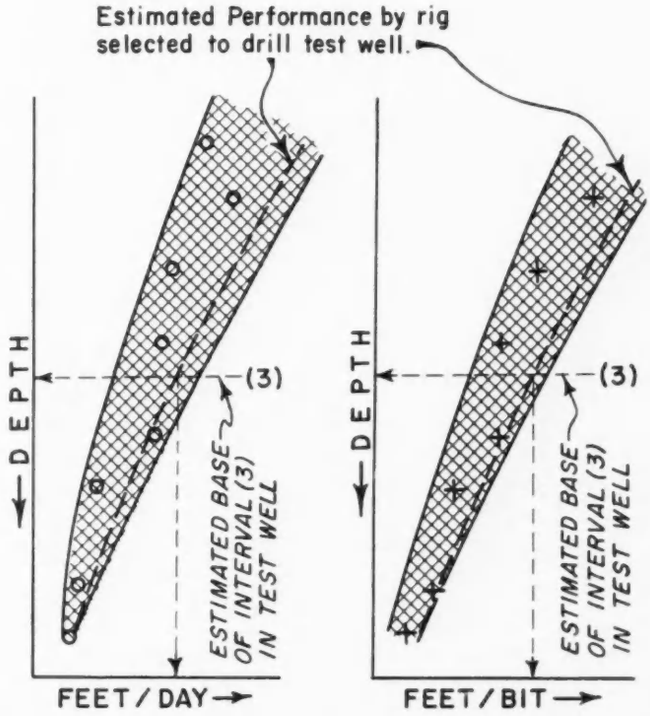



FIGURE 6—The influence of depth on penetration rate and drilling bit footage is established for each depth increment represented on the well profile (Figure 5).

**Evaluating the estimate.** Having estimated the feet per day and feet per bit for each interval, the next step is to construct composite net drilling time and bit requirement curves from surface to total depth of the interval studied (Figure 7). The reasonableness of these forecast net drilling time and bit curves can be weighed against the actual performances of the wells on the profile in the manner illustrated in Figure 7.

**Determining contractor days and bits.** In Figure 8, the same net drilling time curve is constructed as estab-

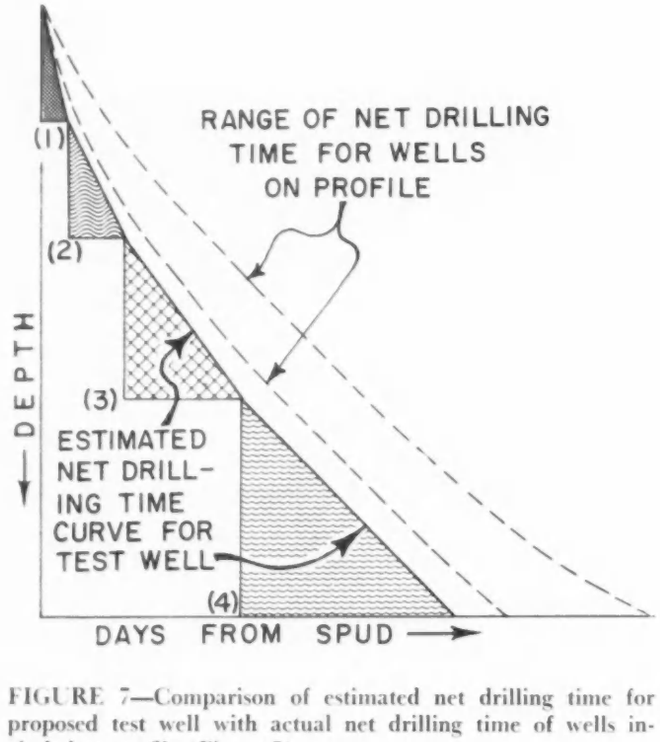



FIGURE 7—Comparison of estimated net drilling time for proposed test well with actual net drilling time of wells included on profile (Figure 5).

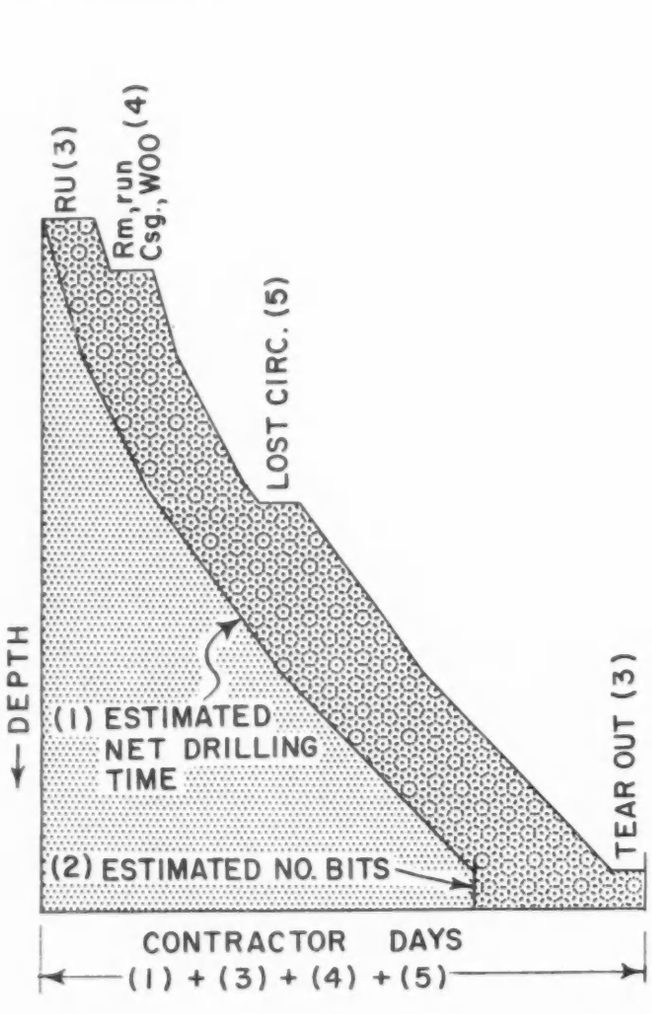



FIGURE 8—Estimated "Contractor Days" for proposed test well consist of net drilling time plus "Fixed Cost" items involving rig time.

lished in Figure 7. To this curve are added the other items shown in Figure 1 representing additional contractor rig days which constitute a part of the footage cost. This final curve of depth versus days as well as bit requirements should be closely approximated in the test well if the estimate has been properly prepared. Experience has shown that it is desirable to provide the drilling superintendent and tool pusher of the rig concerned with copies of this finished curve (Figure 8), which permits daily comparison with actual performance.

**Summary.** The profile method of forecasting drilling penetration rates and bit footages has been time tested in many areas by contractors and operators and found to be accurate when properly applied. The method described may appear highly technical, tedious and time consuming. However, as facility is acquired, such analyses of forecasting drilling penetration rates and bit footage may be made in six to twelve hours depending on the amount of control available, the depth of the test well, and presence or absence of abnormal problems anticipated. —**The End**

## About the Authors

**O. E. Mecham,** vice president and manager of Drilling Analysis Service Co., is a recognized expert in the field of drilling analysis. Prior to joining DASCO in 1958 he was vice president and Rocky Mountain manager of Delta Drilling Company, second largest drilling firm in the world. Previous associations with major oil companies include service with Shell Oil Company in petroleum engineering, production and drilling departments on the West Coast and Gulf Coast areas; also with Standard Oil Company of California in production, and drilling departments on the West Coast. Mecham also spent considerable time in foreign service with Shell in The Hague, Holland technical headquarters, Romania, Egypt, Trinidad, British West Indies, and in Saudi Arabia for Delta. Since joining DASCO, business activities have taken him to Argentina and also involved work on projects in Algeria, Israel and Canada. He is a past director and vice president of the Denver Petroleum Club and active in AAODC, RMOGA and API. He is a graduate of Stanford University in Petroleum Engineering.

**M. S. Legge,** assistant manager of Drilling Analysis Service Co., holds a B.S. degree in petroleum engineering from Texas Technological College. Legge was first employed by Pan American Petroleum Corporation in 1946 and worked in various engineering capacities until 1951 when he enrolled in Colorado School of Mines for post graduate work in petroleum production engineering. He joined the consulting petroleum engineering firm, E. A. Polumbus, Jr., and Associates, in 1954 and has been closely associated with the related organization, Drilling Analysis Service Co. since that date. He is active in API, AIME, AAODC and is a member of the Denver Petroleum Club.

# 1. CARE AND MAINTENANCE OF TOOL JOINTS

**By Sterling G. Marshall,** Tubular Products Engineer
**C. R. Frederick,** Administrative Assistant, Reed Roller Bit Co.
Houston

CONSIDERING THE NUMBER of rigs operating and the footage they drill each year, drill string problems today are not excessive. However, when they do occur, they generally are expensive, resulting in fishing jobs or expenditure of money for repairs.

Extensive work has been done and is being carried on today to determine causes of drill string and connection problems. The findings of these investigations can help operators reduce drill string costs.

This is not intended to be only a technical article for engineers. Rather, it is designed to benefit all personnel interested in obtaining the best possible performance from drilling strings. A majority of the more common problems encountered in the field are included.

## THE PROBLEM

To appreciate the recommendations made for the operation and care and maintenance of tool joints and drill collar connections, it is first necessary to understand how connections function.

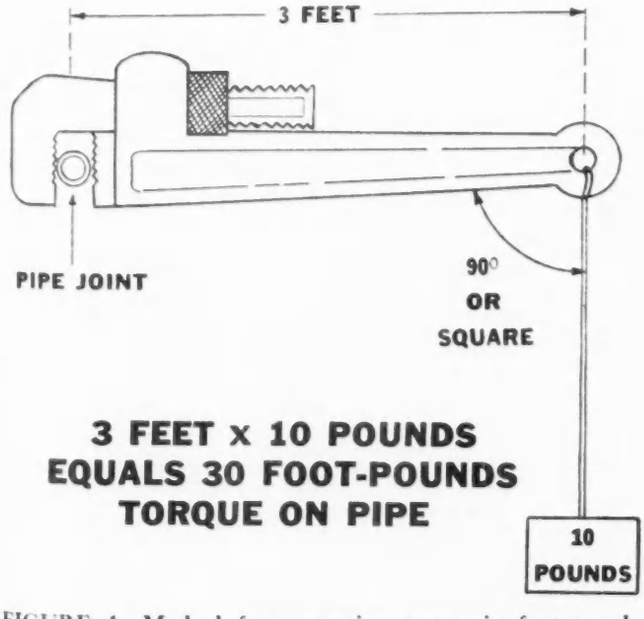



FIGURE 1—Method for measuring torque in foot-pounds.

The API tool joint thread is essentially a 60° V-type thread machined on a taper. A perfect fit would result when both flanks of the pin thread contact both flanks of the mating box thread just as the shoulders of the connection come together in a hand tight make-up.

As the connection is "bucked up" with tongs, the shoulders compress and one flank of the pin thread is forced against one flank of the box thread. The net result is a stretching of the pin and compressing of the box shoulder. There is a clearance between the crest (or top) of one thread and the root (or bottom) of the mating thread, which leaves the connection shoulder as the only positive seal against fluid leakage through the connection.

In addition to acting as a seal, the tool joint shoulder supports the connection at the last engaged thread (⅝-inch from the pin shoulder) which is the point of highest stress concentration. If insufficient make-up torque is used, the connection will not develop maximum strength (see Figure 1). For small size joints (2⅜-inch-3½-inch) being run on larger rigs, care also must be taken not to apply an excessive amount of torque. For instance, note that the upper limit of the recommended torque for the 4-inch API internal flush connection given in Appendix I (16,000 lb./ft.) will yield (permanently elongate the pin) a 2⅞-inch API internal flush connection (Appendix II).

When a drilling string is rotated in a hole, the entire string undergoes torsional and reverse bending stresses. The magnitude of the stresses is influenced by the weight and size of the string, the static, or "built in" stress produced when the connection is tightened with the tongs, the degree or sharpness of bend in the joint, lack of shoulder support from inadequate make-up and other miscellaneous conditions.

Note from the "S-N" curve (Appendix III) of tool joint steel in air that there is a stress reversal which the steel can endure (68,000 psi, or less) and never fail from "metal fatigue." But, as the stress gets above 68,000 psi, the number of cycles which it can endure without failure becomes a finite figure, the higher the stress, the fewer cycles it will take to produce a failure. Observe that at 95,000 psi, it would take only about 50,000 cycles to produce failure. Even higher stress would permit more rapid failure, and it is possible to develop stresses which will produce a connection failure in only one bit run.

The irregular contour of the threaded portion of a tool joint results in "stress concentration" at the root of the thread, and seemingly minor variations in down hole conditions can sometimes produce very high stresses in the joint.

When a drilling string is operated in a corrosive medium, the life expectancy is materially reduced because the number of stress reversals required to produce failure at a given stress magnitude is considerably lower than when operating in a non-corrosive medium. Drill pipe life often is greatly reduced, and occasionally tool joint connections fail as a result of fatigue cracks which originate in the bore.

Other troublesome connection problems which develop consist of washouts, thread and shoulder galls, shoulder upsetting, broken and sharpened threads, and eccentric OD wear. These alone can be costly, but they indicate poor practices in operation or handling, which can lead to the more serious connection failure and fishing job.

## CAUSES OF TOOL JOINT FAILURES

The following photographs illustrate typical tool joint troubles and failures encountered in the field. Many failures resulted from conditions or practices under the control of the operator or his personnel.

Most failures shown are serious. They progressed too far to repair in the field. However, an alert crew would have observed early indications of developing troubles which many of these undoubtedly gave. Prompt corrective action and repairs could have prevented many of these failures.

Periodic inspections by qualified personnel often can stop drill string problems before they start. Anytime damage is suspected and the operating personnel cannot correct the cause, help should be sought. Many companies which specialize in inspection and repair can offer advice and even put your drill string in good condition. But economical correction requires early detection, so don't wait until it is too late.

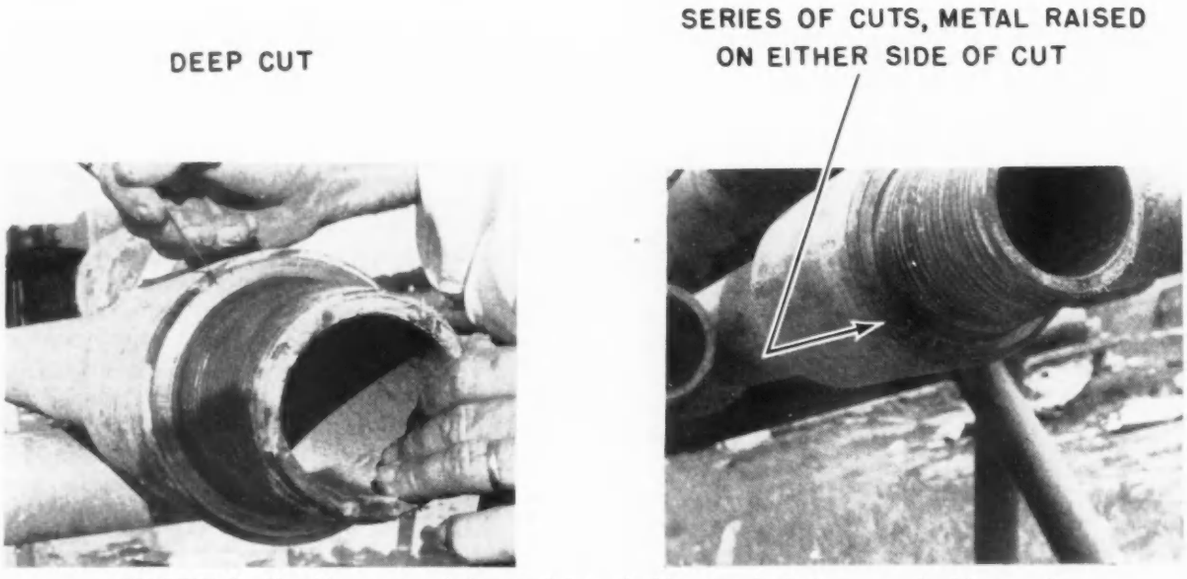



FIGURE 2—Shoulders cut and damaged from jacking stand of pipe around with wrench.

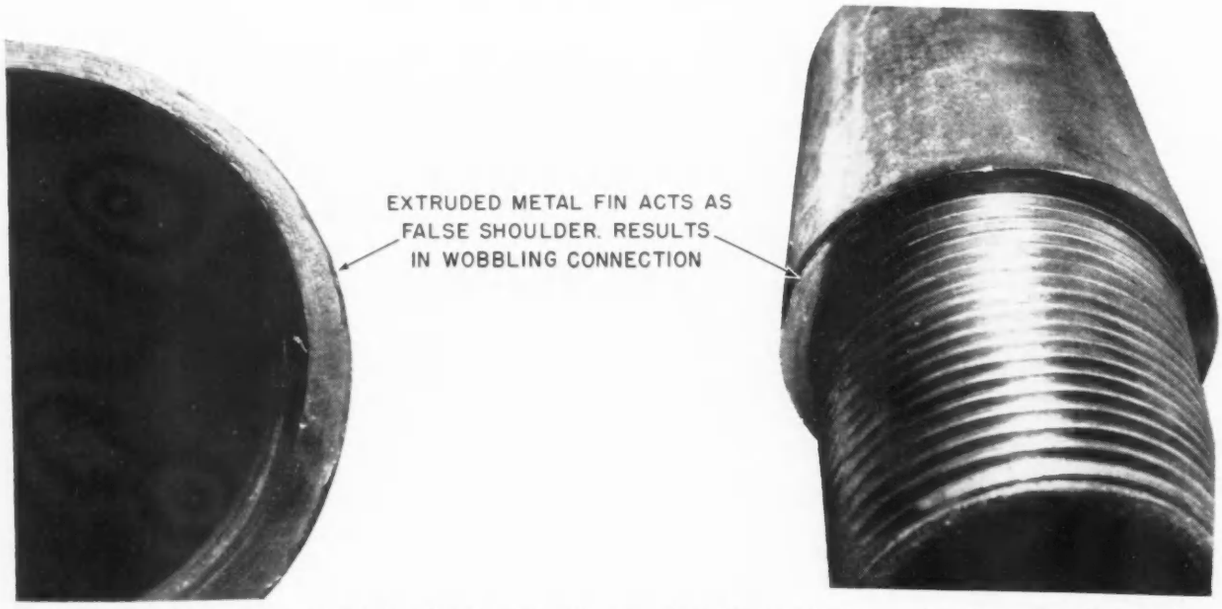



FIGURE 3—Metal fin on tool joint shoulder can develop when pin or box is mated with smaller diameter box or pin. It is produced by constant pounding of larger diameter joint against wall of hole.

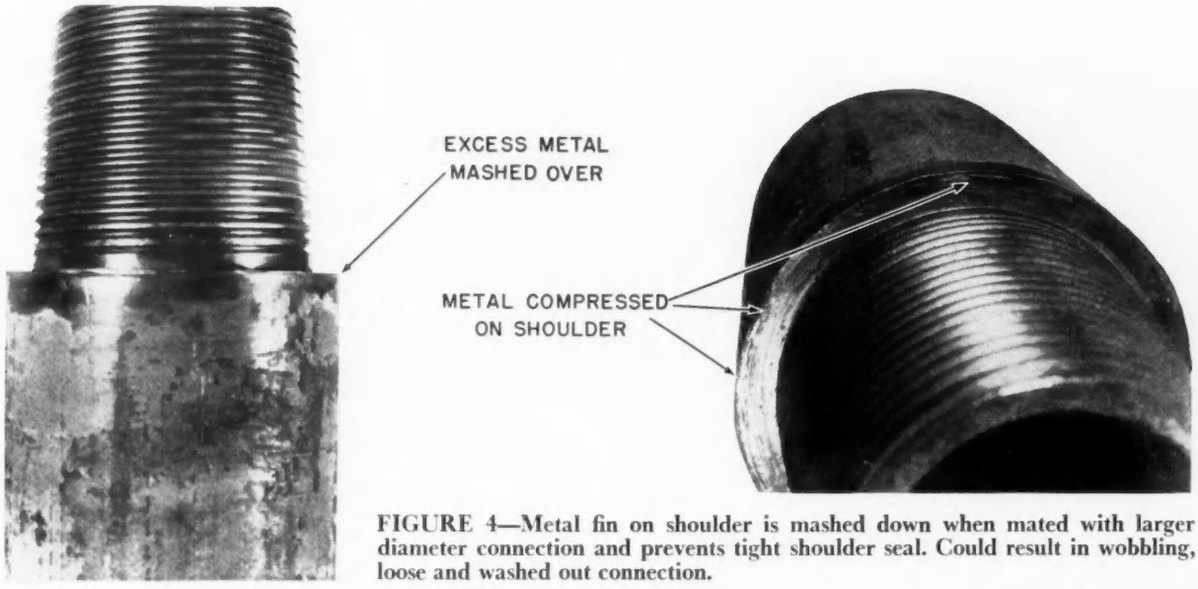



FIGURE 4—Metal fin on shoulder is mashed down when mated with larger diameter connection and prevents tight shoulder seal. Could result in wobbling, loose and washed out connection.

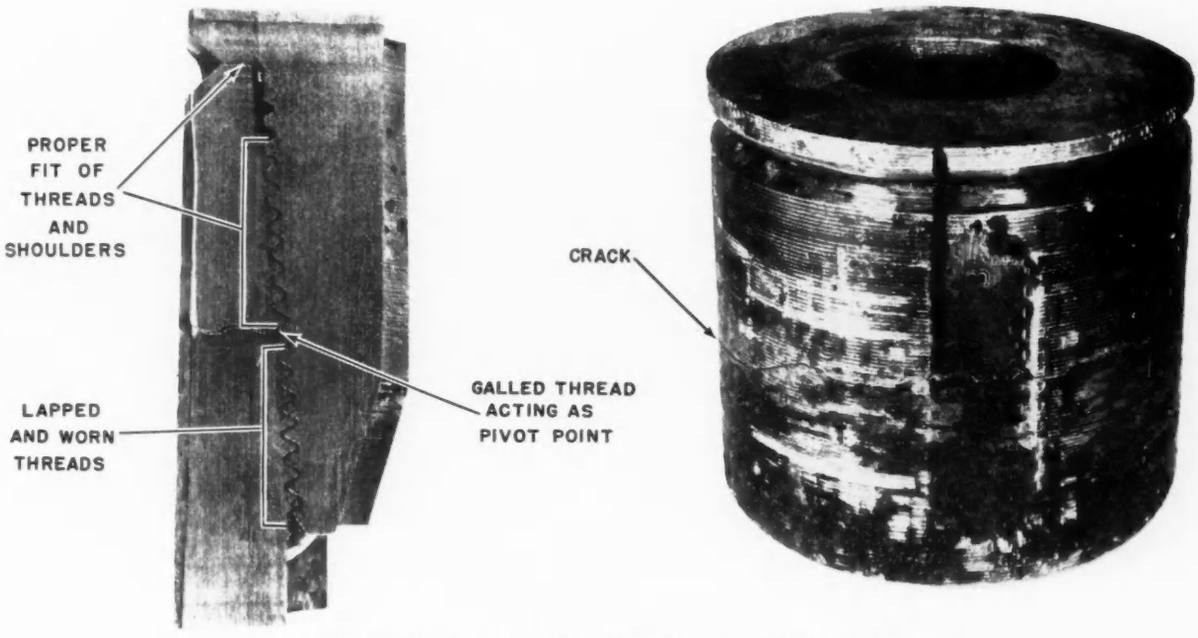



FIGURE 5—Galled thread resulting in fatigue crack in drill collar box.

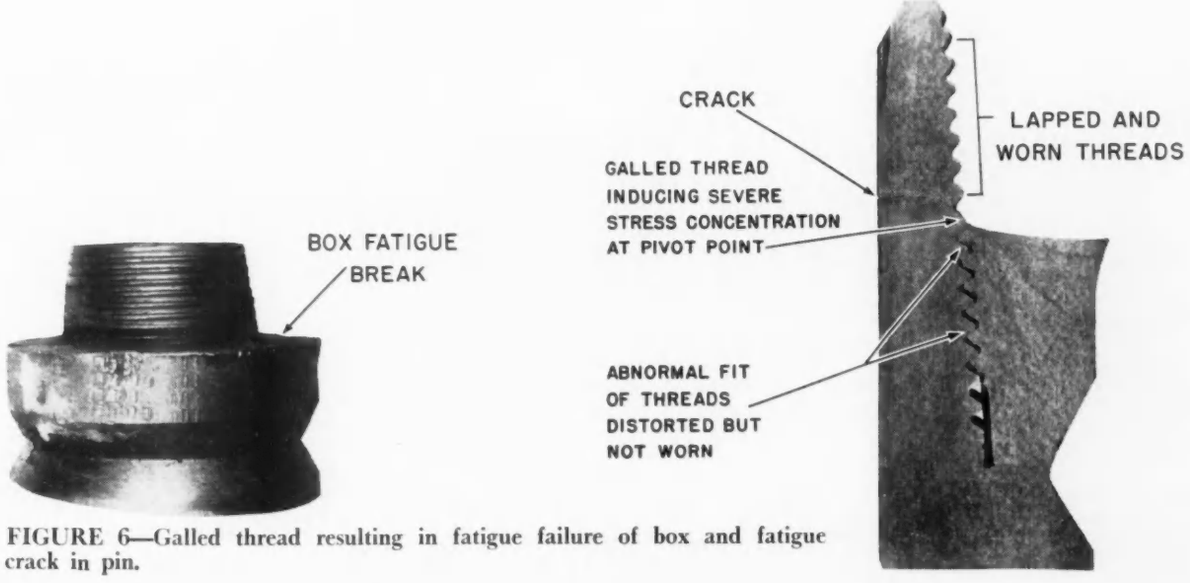



FIGURE 6—Galled thread resulting in fatigue failure of box and fatigue crack in pin.

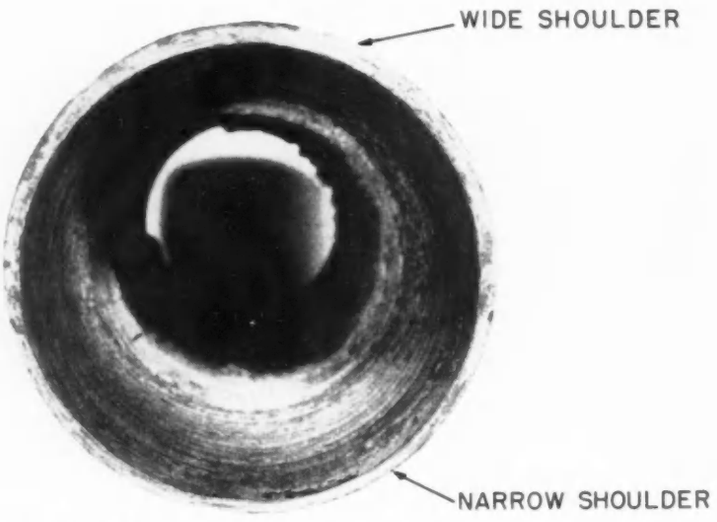



FIGURE 7—Eccentric OD wear resulting from crooked drill pipe.

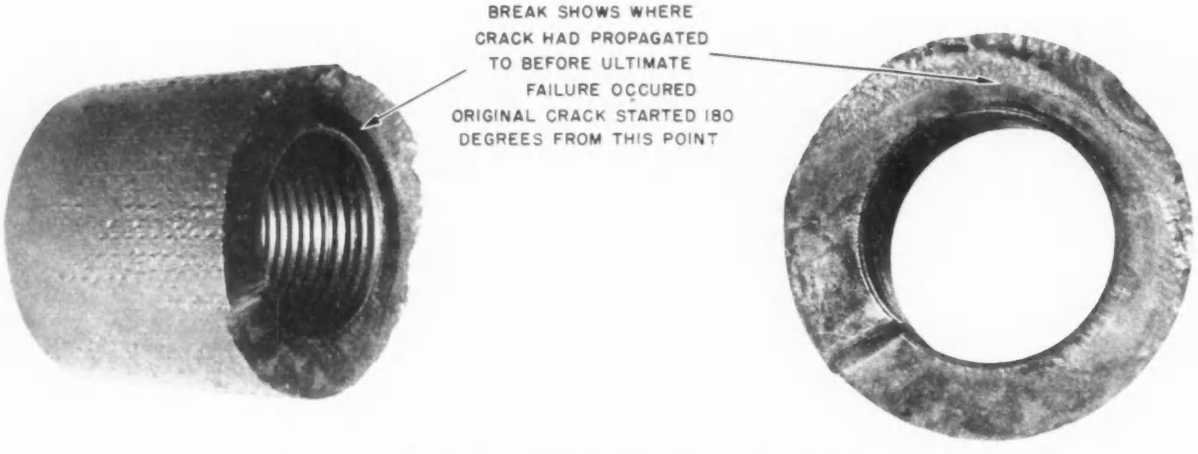



FIGURE 8—Box failure from fatigue accelerated by corrosion.

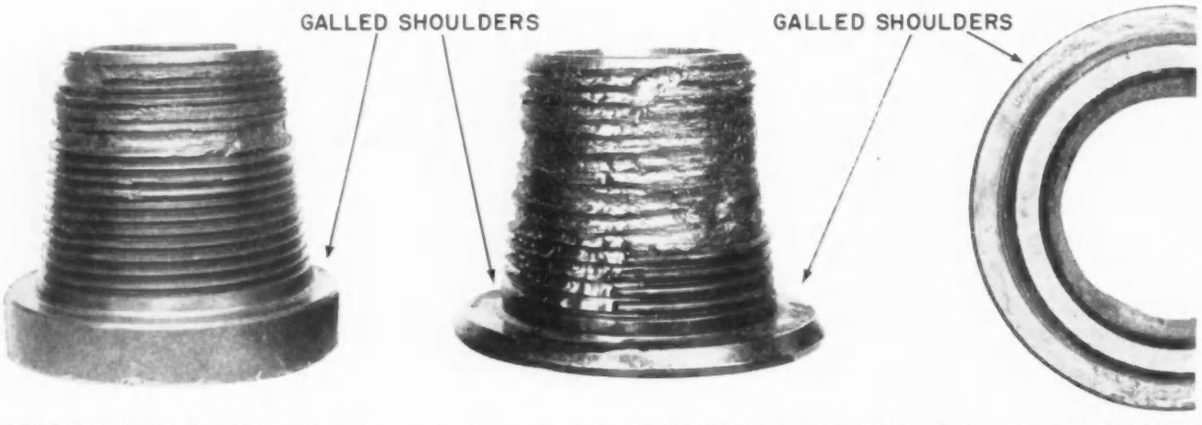



FIGURE 9—Damaged or dirty connections or improper lubrication causes galling of threads and shoulders. Wobbling and washouts result.

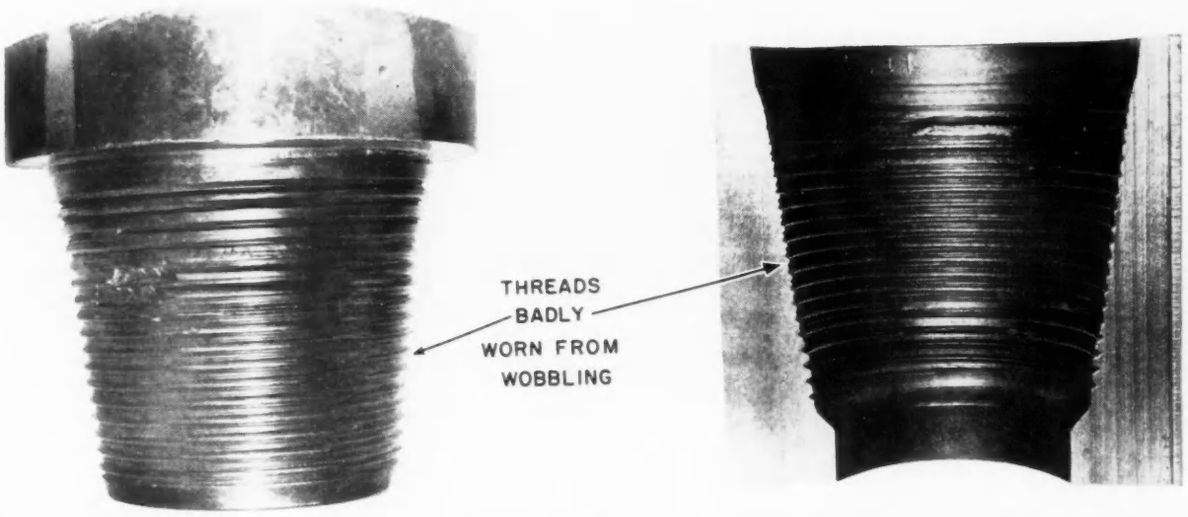



FIGURE 10—"Frozen" connection from excessively galled threads. Shoulders were not made up sufficiently tight and connection pivoted at point of galling, allowing connection to wobble.

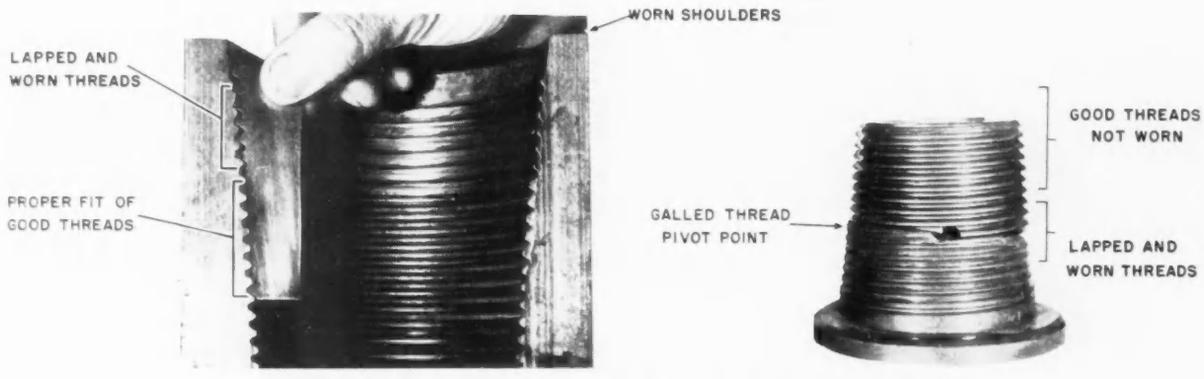



FIGURE 11—Wobble failure . . . broken pin resulting from thread gall.

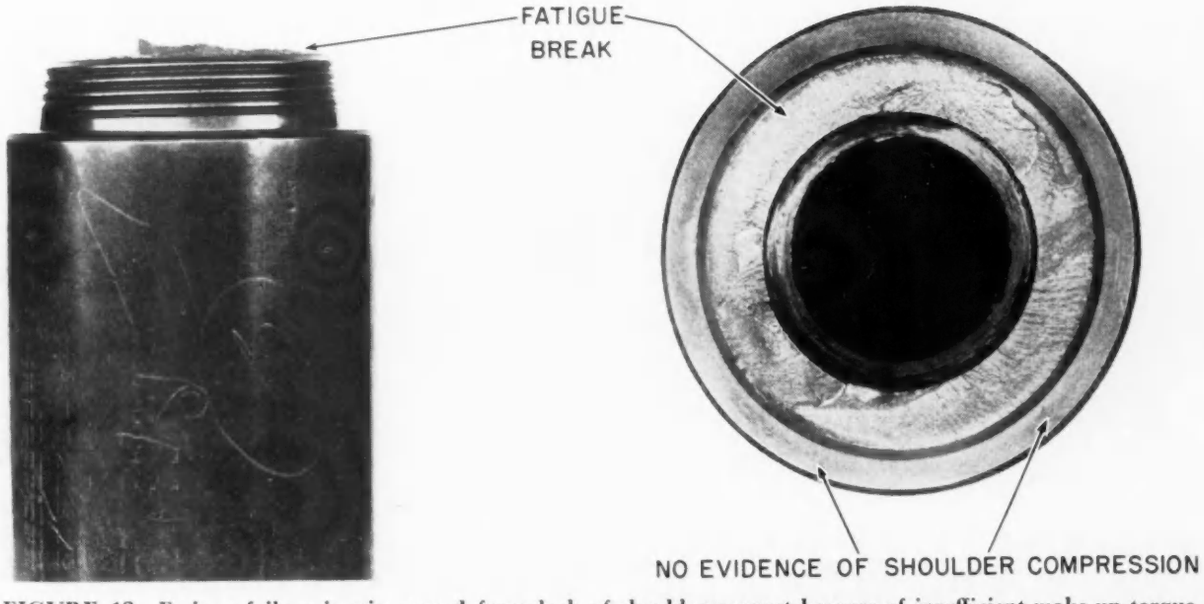



FIGURE 12—Fatigue failure in pin caused from lack of shoulder support because of insufficient make-up torque. Connection will not develop maximum strength without good shoulder support.

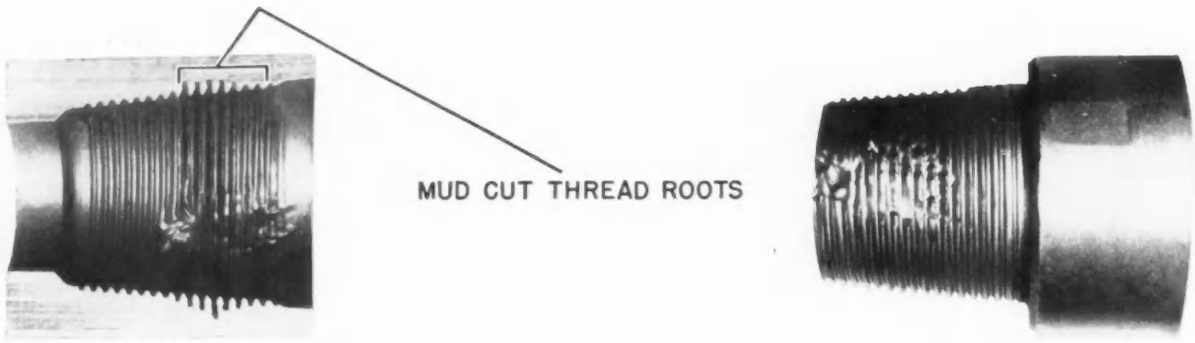



FIGURE 13—Connection not tightened with tongs . . . washing resulted from complete absence of shoulder seal.

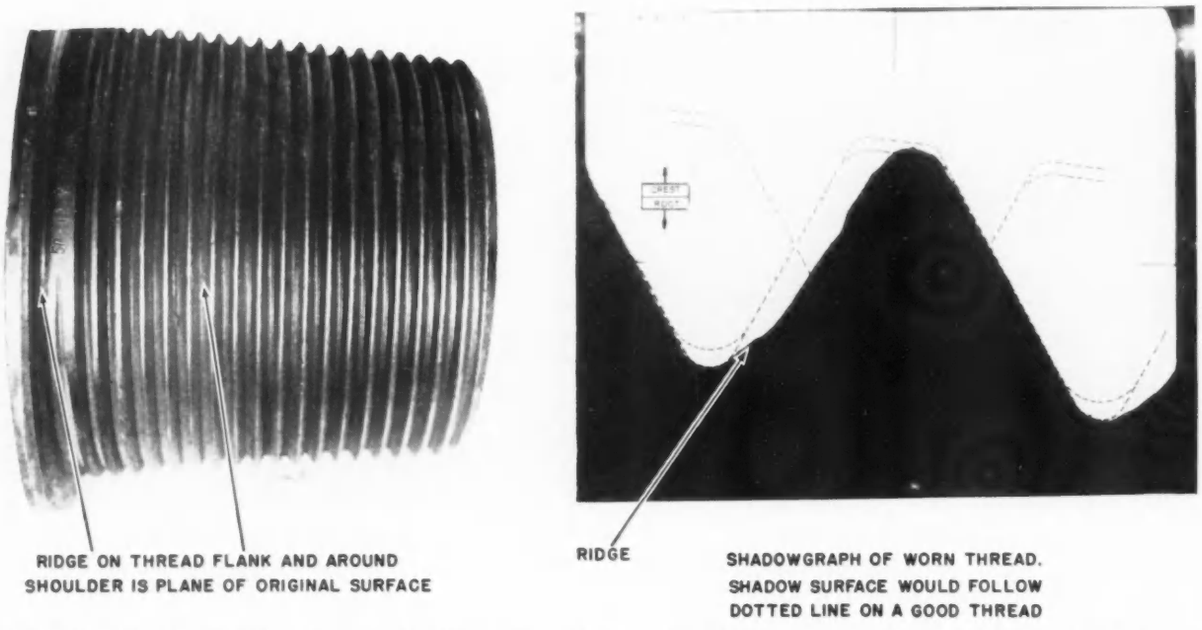

RIDGE ON THREAD FLANK AND AROUND SHOULDER IS PLANE OF ORIGINAL SURFACE
RIDGE
SHADOWGRAPH OF WORN THREAD. SHADOW SURFACE WOULD FOLLOW DOTTED LINE ON A GOOD THREAD

FIGURE 14—Lapped threads and shoulders are evidence of wobbling connection caused from insufficient make-up torque. Ridge around shoulder and ridge around thread flank indicates the connection was working on these surfaces.

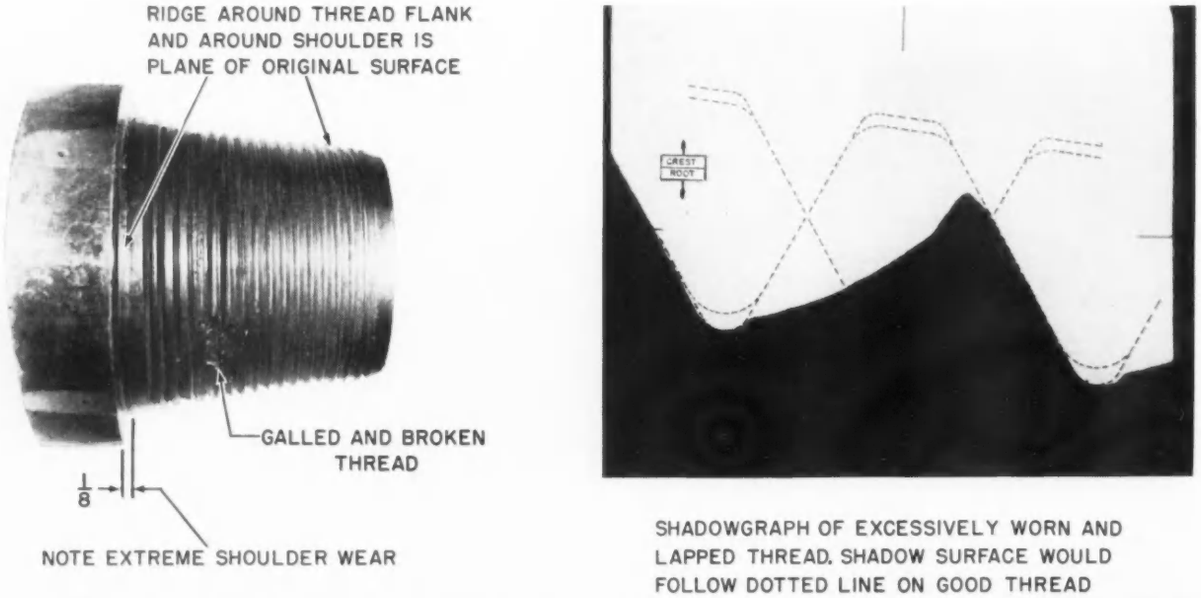

RIDGE AROUND THREAD FLANK AND AROUND SHOULDER IS PLANE OF ORIGINAL SURFACE
GALLED AND BROKEN THREAD
1/8
NOTE EXTREME SHOULDER WEAR
SHADOWGRAPH OF EXCESSIVELY WORN AND LAPPED THREAD. SHADOW SURFACE WOULD FOLLOW DOTTED LINE ON GOOD THREAD

FIGURE 15—Excessively lapped threads and shoulders resulting from wobbling due to galled thread which locked connection on gall before sufficient shoulder tightness was possible.

FIGURE 16—Insufficient make-up torque allows wobbling in connection producing heavily lapped, sharp and broken threads and broken pins.

FIGURE 17—Washed out connection due to wobbling. Insufficient make-up torque.

FIGURE 18—Gall on shoulder prevented shoulders sealing so that preliminary washing occurred.

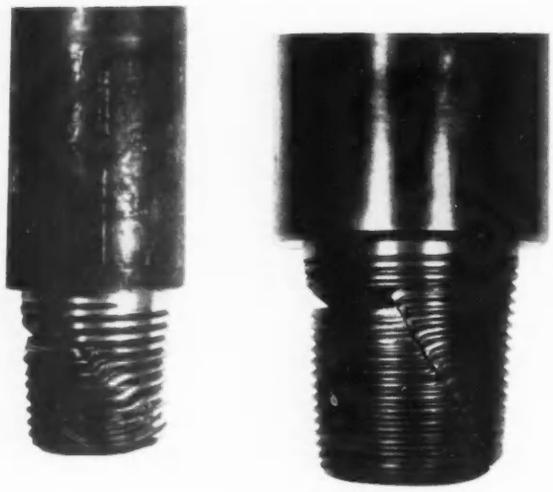



FIGURE 19—Excessive torque resulting in diagonal shear across pin at 90 degrees from tension fracture.

FIGURE 20—End view shows displaced metal on bearing surface of shoulder.

SHOULDER COMPRESSION IS NOT EVIDENT ON THESE TWO BOXES
EXTRUDED METAL TOWARDS OUTER EDGE
INDICATES SHOULDER COMPRESSION

FIGURE 21—Excessive high torque displaces metal on shoulders, resulting in extreme shoulder compression of box and pin.

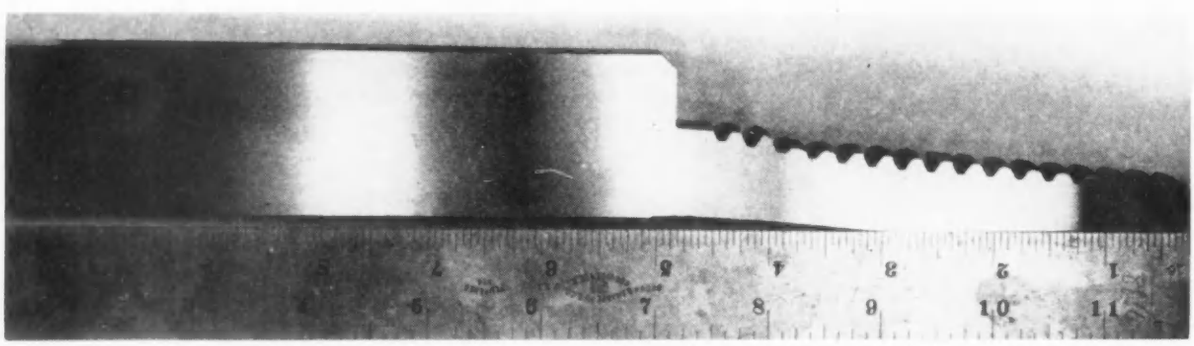


FIGURE 22—Neck down in bore of pin from excessive torque.

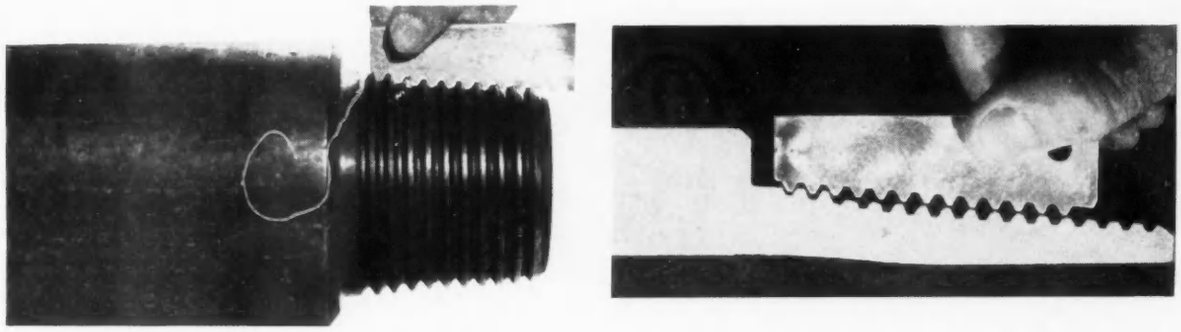


FIGURE 23—Improper fit of thread profile gage indicating distortion in the thread lead from excessive torque.

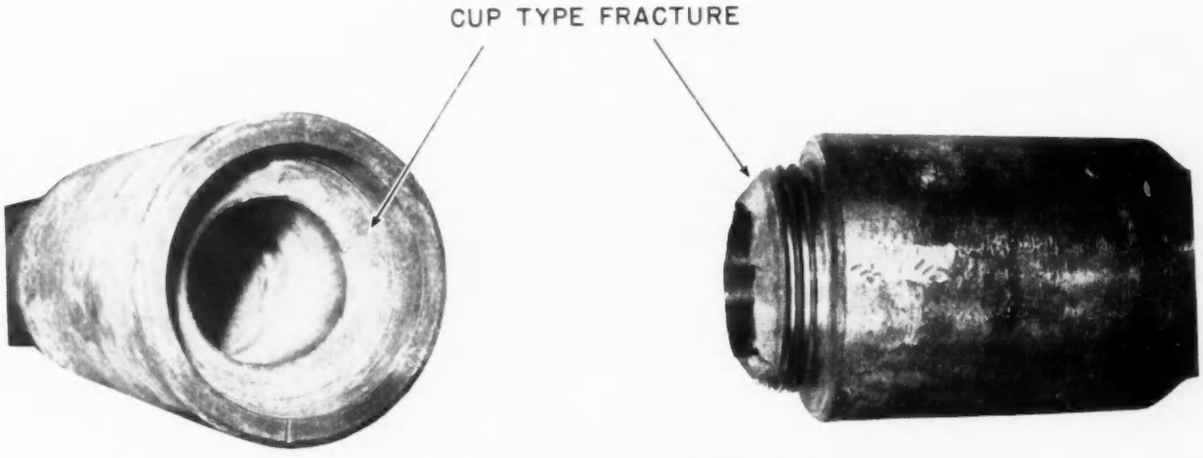



FIGURE 24—Tension failure due to excessive torque.

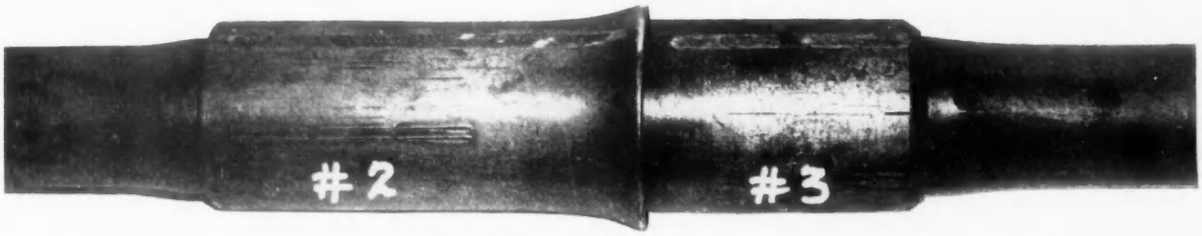



FIGURE 25—Belled out box with pin made up, caused by excessive torque developed down the hole.

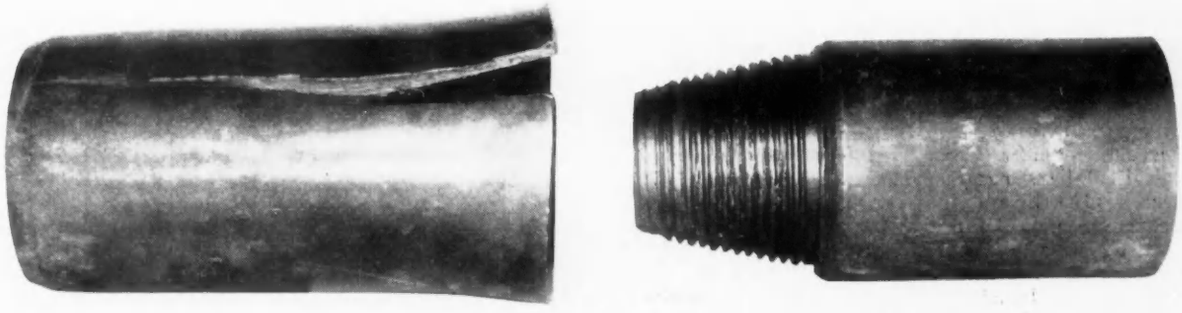


FIGURE 26—Excessively high torque developed during drilling resulting in belled out and split box, swaged pin and sheared shoulder of pin.

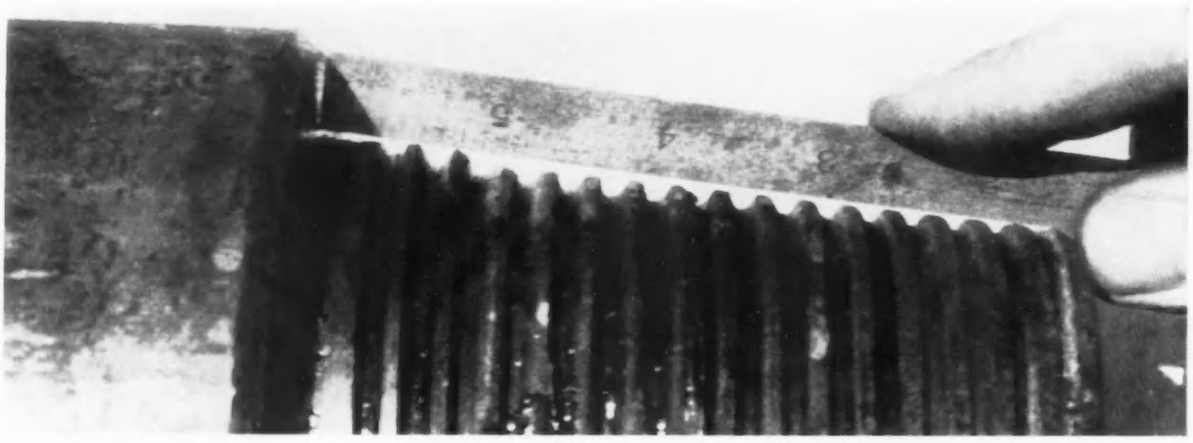


FIGURE 27—Excessive torque—either downhole or make-up in the rotary table—resulted in stretched and necked down pin.

## About the Authors

Marshall

Frederick

**Sterling G. Marshall** joined Reed Roller Bit Company in 1934 in Houston in the Inspection Department. He served as a quality control supervisor in both the oil tool and war products plants during World War II. He joined the Product Engineering Department in 1945 as an engineer, and moved to West Texas in 1947 as a field engineer. He returned to Houston in 1953 as a product engineer. He is currently tubular products engineer.

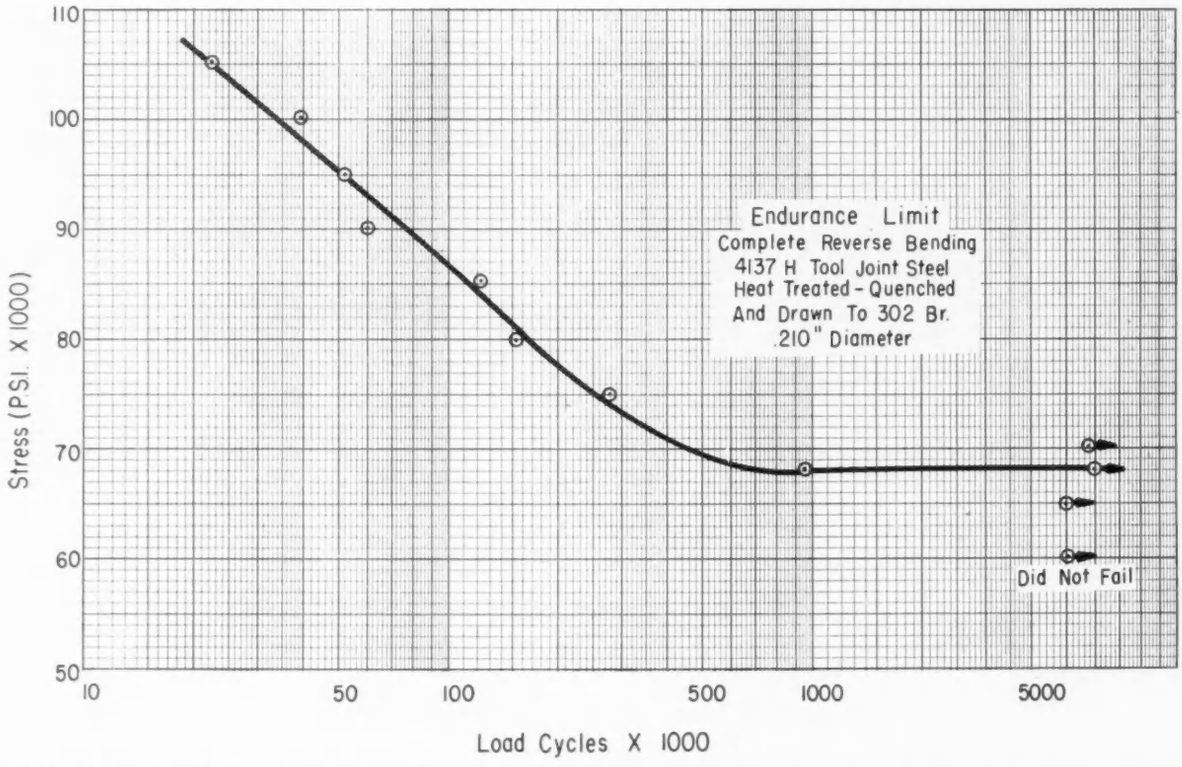
**C. R. (Bob) Frederick** received his B.S. degree in mechanical engineering from The University of Texas in 1944. Following a tour of duty with the U.S. Navy, he joined Reed Roller Bit Company in 1946 in Houston, where he served as draftsman, drawing checker and engineer. From 1949 through 1958 he served as field engineer in Oklahoma, Kansas, North Texas and California. In 1959 he served as technical representative for the northern half of South America, based in Maracaibo, Venezuela. In 1960 he returned to Houston where he is an administrative assistant.

## Appendixes

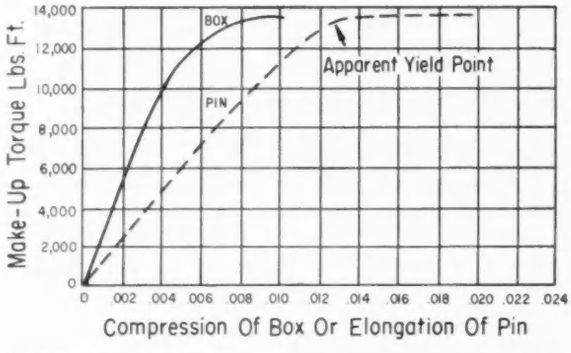
### APPENDIX I—Recommended Make-up Torque

| Size | Type of Connection | OD | ID | NOMINAL LINE PULL-POUNDS 3 Ft. Tong | NOMINAL LINE PULL-POUNDS 4 Ft. Tong | TORQUE—POUND-FEET Minimum | TORQUE—POUND-FEET Maximum |
|---|---|---|---|---|---|---|---|
| | Wide Open | 3 1/8 | 2 | 700 | ..... | 1,600 | 2,400 |
| | Wide Open | 3 1/4–3 3/8 | 2 | 750 | ..... | 1,900 | 2,600 |
| | API Regular | 3 1/8 | 1 | 1,000 | ..... | 2,500 | 3,500 |
| 2 3/8 | Full Hole | 3 3/8 | 1 7/16 | 1,200 | ..... | 3,000 | 4,000 |
| | API Internal Flush | 3 3/8 | 1 3/4 | 1,000 | ..... | 2,500 | 3,500 |
| | External Flush Full Hole | 2 1/2 | 1 | 700 | ..... | 1,600 | 2,400 |
| | External Flush Small Hole | 2 3/8 | 7/8 | 700 | ..... | 1,600 | 2,400 |
| | Wide Open | 4–4 1/8 | 2 7/16 | 1,000 | ..... | 2,500 | 3,500 |
| | API Regular | 3 3/4 | 1 1/4 | 2,000 | ..... | 5,000 | 7,000 |
| | Full Hole | 4 | 1 7/8 | 1,750 | ..... | 4,500 | 6,000 |
| | API Internal Flush | 4 1/8 | 2 1/8 | 1,750 | ..... | 4,500 | 6,500 |
| 2 7/8 | Extra Hole | 4 1/4 | 1 7/8 | 2,350 | ..... | 6,000 | 8,000 |
| | Double Streamline | 3 1/4 | 1 1/4 | 1,350 | ..... | 3,500 | 4,500 |
| | External Flush Full Hole | 3 | 1 1/4 | 950 | ..... | 2,250 | 3,300 |
| | Slim Hole | 3 3/8 | 1 3/4 | 1,000 | ..... | 2,500 | 3,500 |
| | Full Opening | 3 7/8 | 2 5/32 | 1,200 | ..... | 3,000 | 4,000 |
| | Wide Open | 4 3/4 | 3 | 1,500 | 1,150 | 4,000 | 5,000 |
| | API Regular | 4 1/4 | 1 1/2 | 2,700 | 2,000 | 7,000 | 9,000 |
| | API Full Hole | 4 5/8 | 2 7/16 | 2,200 | 1,650 | 5,500 | 7,500 |
| | API Internal Flush | 4 3/4–5 | 2 11/16 | 3,000 | 2,250 | 8,000 | 10,000 |
| 3 1/2 | Extra Hole | 4 7/8 | 2 7/16 | 2,700 | 2,000 | 7,000 | 9,000 |
| | Double Streamline | 3 7/8 | 1 13/16 | 2,700 | 2,000 | 3,500 | 4,500 |
| | External Flush F. H. | 3 11/16 | 1 1/2 | 1,500 | 1,150 | 4,000 | 5,000 |
| | Slim Hole | 4 1/8 | 2 1/8 | 1,850 | 1,400 | 4,500 | 6,500 |
| | Wide Open | 5 5/8–5 3/4 | 3 7/16 | 4,000 | 3,000 | 10,000 | 14,000 |
| | API Full Hole | 5 1/4 | 2 13/16 | 3,500 | 2,650 | 9,000 | 12,000 |
| 4 | API Internal Flush | 5 3/4 | 3 1/4 | 4,600 | 3,450 | 11,500 | 16,000 |
| | Double Streamline | 4 1/2 | 2 3/8 | 2,350 | 1,750 | 6,000 | 8,000 |
| | Slim Hole | 4 1/2 | 2 9/16 | 2,350 | 1,750 | 6,000 | 8,000 |
| | Wide Open | 5 7/8 | 3 7/8 | ..... | 2,450 | 8,500 | 11,000 |
| | Wide Open | 6 | 3 7/8 | ..... | 3,000 | 10,000 | 14,000 |
| | Wide Open | 6 1/8 | 3 7/8 | ..... | 3,250 | 11,000 | 15,000 |
| | API Regular | 5 1/2 | 2 1/4 | ..... | 3,250 | 11,000 | 15,000 |
| | API Full Hole | 5 3/4–6 | 3 | ..... | 3,650 | 12,000 | 17,000 |
| 4 1/2 | API Internal Flush | 6 1/8–6 1/4 | 3 3/4 | ..... | 3,650 | 12,000 | 17,000 |
| | Extra Hole | 6 | 3 1/4 | ..... | 3,450 | 11,500 | 16,000 |
| | Double Streamline | 5 | 2 11/16 | ..... | 2,250 | 8,000 | 10,000 |
| | External Flush F. H. | 4 11/16 | 2 3/16 | ..... | 2,450 | 8,500 | 11,000 |
| | Slim Hole | 5 | 2 11/16 | ..... | 2,250 | 8,000 | 10,000 |
| 5 | Extra Hole | 6 1/4 | 3 3/4 | ..... | 3,650 | 12,000 | 17,000 |
| | API Regular | 6 3/4 | 2 3/4 | ..... | 5,500 | 19,000 | 25,000 |
| | API F. H. | 7 | 4 | ..... | 5,100 | 17,000 | 23,500 |
| 5 1/2 | API I. F. | 7 3/8 | 4 13/16 | ..... | 5,000 | 16,500 | 23,000 |
| | Double Streamline | 6 1/8 | 3 3/4 | ..... | 3,650 | 12,000 | 17,000 |
| 6 5/8 | API Regular | 7 3/4 | 3 1/2 | ..... | 6,600 | 22,500 | 30,000 |
| | API F. H. | 8 | 5 | ..... | 5,500 | 19,000 | 25,000 |
| 8 5/8 | API Regular | 10 | 4 3/4 | ..... | 11,250 | 40,000 | 50,000 |

This table gives both recommended make-up torque and recommended nominal line pull to aid users in applying correct make-up torque. A tong torque gage or indicator is definitely recommended. If the gage has a scale to read line pull, no adjustments are needed. Some indicators are designed to trip when a predetermined pull is reached. These units should be reset whenever pipe size or tong length is changed.




APPENDIX II—The compression of a box or elongation is shown above. For a 2⅞-inch API-IF pin at the gage point, the tension area is equal to 3.82 square inches while the compression area of a 4⅛-inch x 2⅛-inch ID box is equal to 4.31 square inches.




APPENDIX III—The stress reversal which a tool joint steel can endure and never fail from "metal fatigue."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Air drilling safety recommendations observed in this photograph are: (1) "No Smoking" signs prominently displayed; (2) spark arresting mufflers on compressor engines. Note trailers are at least six feet apart; (3) mud pit in readiness for emergency use; (4) mud pump immediately operable for killing well or firefighting with mud guns.

DRILLING PROGRESS

# Check list minimizes accidents while drilling with gaseous fluids

## Safety must be understood and practiced by all personnel when using gaseous fluids as the circulating medium

**By Gordon Jackson,** President,
Well Completions, Inc., Denver

As AIR DRILLING finds increased application in drilling, completion, and workover, a guide to safety planning and operations will simplify the work of responsible supervisory personnel. Such a guide has been developed, using the check list technique and based upon currently employed safety practices. A discussion of each check list will contain recommendations keyed to the appropriate check list question.

The close relationship between drilling with air and drilling with natural gas makes it advisable to include ref-

erences to the latter medium. With only the slightest alterations, the check list for air drilling safety can be used for natural gas drilling safety.

**Growth and safety of air drilling.** During 1960, it is estimated that air or natural gas may be used in at least 10 percent of all wells drilled in the United States. On this basis it is not unreasonable to assume that with the growing number of tools, methods and techniques, a gaseous drilling fluid will be circulated in more than 30 percent of new holes begun in 1963. Closed circuit drilling, redesigned and improved compressor packages, and advanced air drilling methods are also destined to boost the use of air and natural gas in workover and completion work.

More experienced crews, as might be found in the Rocky Mountain or Appalachian areas, are continually being trained in air drilling safety. Special safety lessons and practices are quickly learned and easily applied.

Safe operations in the future, as in the past, will depend on how all concerned in the drilling operation reduce the statistical probability of accident by planning for safety.

**Who is responsible?** During air drilling operations, three managements or operating functions are represented on location: Operator, drilling contractor, and the air drilling engineering service company. Each has certain obligations and responsibilities.

**Operator:** In most cases it is the operator who chooses to use air or gas as the circulating medium. He is obligated to the drilling contractor, as well as to himself, to select a competent service company that is technically capable and safety conscious. Maximum safety during air drilling is the operator's best assurance that his lease investment will be protected; that his obligations to the lessor will be free of unnecessary liabilities; and that the expected value of the production from the lease will not be burdened with excessive drilling or completion costs.

**Drilling Contractor:** Special attention and instructions regarding safety during air drilling operations means that the contractor will not incur unusual insurance premiums. More important is the protection, through safety, of his investment in rig and equipment. Safety assures the contractor of fulfilling his contract obligations; that he is able to perform work required of him, his personnel and his equipment satisfactorily, speedily and profitably.

**Air Service Company:** The air drilling service company, because of its broad and varied experience, is obligated to reduce and overcome any dangers or hazards which are unique to its services. To ensure strict observance of necessary precautions, the service company should offer safety instruction to all personnel connected with the specialized air or gas drilling operation.

**Planning before drilling.** The first opportunity for planning comes when an operator consults with an air drilling engineering service regarding feasibility at a specific location. In many cases, the operator divulges private information on expected engineering and geological problems. The professional, confidential relationship between operator and air drilling engineers contributes greatly to later presentations and acceptance of safe operating recommendations.

Once the feasibility and economy have been established for an air drilling program, management level discussions will focus on drilling practices, special equipment needs, fluid entry control methods and materials, and location of equipment and material at the drill site.

Discussions of safety at such a meeting are of a general nature. Since much of safety planning aids in efficient operations, it is the responsibility of the air drilling service company to provide as much safety information as may be desired.

After the drilling contractor has been selected, specific recommendations and instructions are made at pre-work safety planning meetings.

Pre-work safety meetings often include representatives of the three management groups. Among those who have participated at pre-drilling safety meetings in behalf of the operator are drilling superintendents, drilling engineers, safety engineers, production engineers and geologists.

Among those who have represented the drilling contractor are drilling superintendents, toolpushers and safety engineers. Some contractors might include the drillers, if available. A number of reasons have been given. The most significant one appears to be that the drillers profit from a greater sense of participation at the management-supervisory level.

The air service company may be represented by any qualified engineer or field supervisor. It may be the engineer with whom previous consultation had been held, the engineer who will actually be on the job, or another experienced air drilling technician who has studied the prognosis for air drilling at the proposed location.

**Prework briefing sessions-drilling crews.** The meeting may begin with a general review of surface and subsurface conditions. If water, gas, or oil is likely to be encountered above the target zone, and would require special awareness or treatment, mention should be made. Plans should be made in advance to cope with expected and unexpected hazards.

The check list is covered step-by-step. Especially where drilling crews have had no previous air drilling experience, the operator and contractor may find it constructive to lean upon the representative of the air service company for "opening remarks."

The air drilling technician is an "outsider." His statements and instructions carry the weight of the combined experience from all jobs performed by his company.

Crewmen will be reminded that, in general, air drilling operations require the same type of safety precautions as conventional drilling. The danger from blowouts is actually lessened since formation fluids or gases are under mechanical control of the rotating blowout preventer. There is no sudden loss of control as when the mud is suddenly and unexpectedly ejected from the hole.

Crews should be reminded that pressured lines in a circulating system are a hazard. Also mention should be made of the toxic qualities of water shut-off gases and even carbon monoxide from rig motors.

As the check list discussion proceeds, responsibilities are made clear in regard to accident prevention, and cooperative efforts in supervising safe, efficient operations. Experience indicates that the greater the mutual understanding and cooperation at the supervisory level, the easier it will be

to maintain safe operating conditions throughout the drilling operations.

During the course of pre-drilling briefing sessions, it is important that supervisory personnel, representing the operator and contractor, make suggestions and recommendations. Crewmen should also be encouraged to ask questions so that any uncertainties may be clarified.

**Using the check lists.** A discussion will flow more smoothly when a prepared outline of subjects is provided. However, it will be found that a thorough discussion of a prework safety planning check list will require reference to the other check list.

### PREWORK SAFETY PLANNING CHECK LIST

**1.** What is the attitude of top management toward safety in general?

**2.** Does planning for safety reflect a strong belief in safety?

**3.** What will be the chain of responsibility for safety progress?

**4.** To what extent will safety responsibility be delegated to supervisors?

**5.** What will be the method for furnishing initial air drilling safety indoctrination to the crewmen?

**6.** What means can be employed for insuring full participation and compliance with all provisions of the safety program by visitors, parties making deliveries of supplies, and other service personnel?

**7.** What will be the program of continuing air safety instruction by means of supervisory safety meetings, tool box meetings, and visual aids, such as safety posters and bulletins?

**8.** What arrangements shall be made for first aid and medical care and transportation of injured?

**9.** What are the responsibilities for prompt investigation of accidents and accident reporting?

**10.** What will be the physical layout of the drilling site?

**11.** Does the layout provide a safe working area for men, equipment and materials?

**12.** Will roads and other access means be safe and efficient? Will maintenance be necessary to keep them that way?

**13.** What shall be done to control traffic and mark hazards (that is, roads, restricted areas, fuel storage, compressor areas)?

**14.** How will coordination of activities between different operations and company personnel avoid unnecessary congestion or accident hazards?

**15.** How will safety be applied to all operating methods and procedures as a normal function, rather than superimposing safety rules or restrictions thereon?

**16.** How specifically will housekeeping and cleanup procedures be carried out throughout the job (by designated cleanup crews, individual company personnel)?

**17.** What is necessary for adequate fire prevention and protection?

**18.** How will adequate lighting and substructure ventilation (including testing confined areas for gases, etc.) be provided?

**19.** Will protective apparel and/or equipment be needed? When? What will be provided and who will provide it?

**20.** How will safety inspection of equipment be made prior to commencement of, and periodically throughout, the job?

### RIGGING UP CHECK LIST

#### Location Layout

**1.** Have roads and work areas been posted with proper warning signs?

**2.** Is compressor area at least 100 feet from rig? Is it visible from driller's location in the rig floor?

**3.** Is main fuel storage area located at least 50 feet from the compressor area?

**4.** Are all fuel lines equipped with shutoff valves?

**5.** Has air supply line been located so that it does not interfere with access to the rig? Is it protected at vehicle crossings? Is it anchored at 50 foot intervals to the standpipe riser or buried?

**6.** Is a supply of mud or water in readiness?

#### Rig Area

**1.** Have all lines been tested for pressure? Leaks repaired?

**2.** Have blowout preventers and rotating head been tested for leaks and malfunctions?

**3.** Has the discharge line been directed downwind or at right angles to the prevailing wind?

**4.** Is the discharge line at least 200 feet long and securely anchored in at least three places?

**5.** Has a sample catcher been installed in the discharge line?

**6.** Have arrangements been made for a pilot flame at the end of the discharge line?

**7.** Is there adequate open space around the end of the discharge line to avoid any possibility of igniting grass, underbrush, or trees?

**8.** Is mud pump immediately operable?

**9.** Are valves and BOP control mechanism located so they can be safely operated if an emergency arises?

**10.** Have kill lines been checked?

**11.** Is substructure adequately ventilated?

**12.** Have generators been removed from rig floor to be operated from a safe distance?

**13.** Does the rig have vapor proof night lighting?

**14.** Do rig motors have spark proof mufflers?

**15.** Are all electric motors vapor proof?

**16.** Have chemical type fire extinguishers been located on rig floor?

**17.** Are crewmen familiar with operation of the bleed-off line from standpipe to discharge line?

**18.** Is the kelly cock operating properly?

#### Compressor area

**1.** Is the compressor area adequately posted with warning signs?

**2.** Are the compressor trailers at least six feet apart?

**3.** Is night lighting equipment vapor proof?

**4.** Do motors have spark arresting mufflers?

**5.** Are at least two chemical fire extinguishers at hand?

**6.** Do compressors have all of the following safety features: unloaders, pop valves, temperature and pressure gages, engine governors, and shut off valves?

**7.** Are compressor engines diesel? If not, have special safety precautions been taken with respect to electrical and ignition systems and volatility of fuel?

**8.** Are all valves and piping of adequate pressure rating?

**9.** Have all lines been pressure tested and leaks repaired?

#### First aid

**1.** Have first aid kits been checked and deficiencies made up?

**2.** Are directions for obtaining medical assistance known or posted?

**3.** What means have been assured to prevent bringing cigarets, lighters, or matches to the rig area?

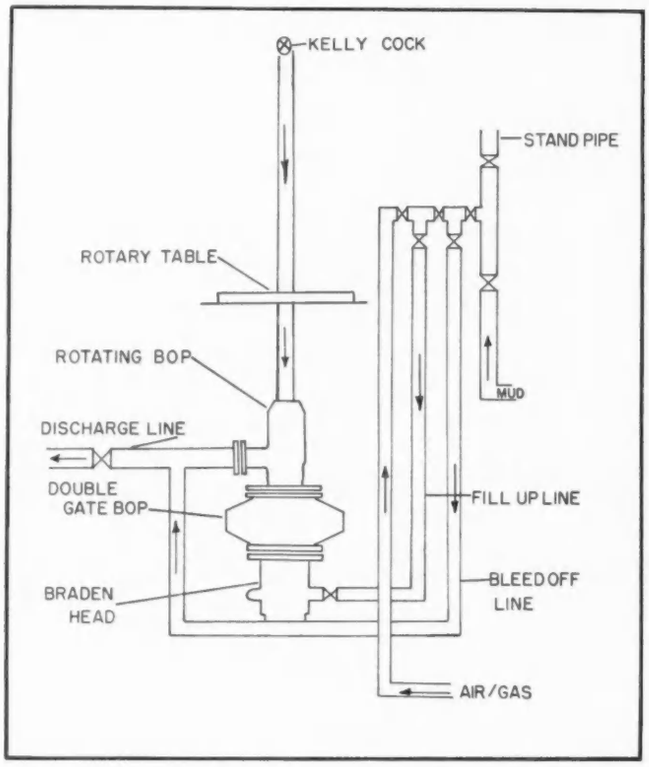


**FIGURE 1—Schematic of a recommended piping diagram. Shown is the hookup in medium pressure ranges where Series 900 API equipment is used. Variations from this diagram are suggested to conform with differing subsurface conditions.**

**4.** What necessary respiratory equipment is on hand?

### Rigging up check list discussion

The words and recommendations of the briefing session are put into practice during rigging up.

• Roads and work areas should be posted with the proper warning signs. Among the most used signs are:

A—CAUTION—AIR (GAS) DRILLING IN PROGRESS

B—DANGER HIGH PRESSURE GAS LINE

C—NO SMOKING

D—NO MATCHES, LIGHTERS OR OPEN FIRES IN THIS AREA.

E—NO UNAUTHORIZED PERSONNEL.

At least 200 yards from the location entrance, the access road should be posted with sign A. Lines carrying natural gas for drilling purposes should be posted with sign B at frequent intervals. Compressor and rig location areas should be posted with signs C, D, and E.

**1.** The air supply line should be anchored at 50-foot intervals to the standpipe riser. Wherever practical, it may be buried. Where vehicles cross the line, it should be protected by earth or planking.

**2.** Provisions should be made to test all lines for leaks prior to drilling. Test pressures should be higher than those expected to be required during drilling. The common practice is to test the system from compressors to rig at maximum available pressure. Faulty valves or gauges are a saftey hazard. They should be replaced or repaired. Pressure must be released before repairing leaks.

**3.** Blowout prevention equipment and rotating head, both of adequate rating should be tested for leaks and malfunctions. The mud pump should be used to test the BOP. Attention should be given to assure proper hookup of equipment and lines below the substructure. (See Figure 1.)

**4.** The discharge (blooey) line is usually of 7-inch diameter.

**5.** A number of sample catchers have been designed for use with air and gas drilling.[2] During drilling operations with gas, catching samples before they are "cooked" in the flow line flare is helpful to accurate geological interpretation.

**6.** During gas drilling, or if gas bearing zones are expected, a pilot flare should be maintained at the end of the flow line.

**7.** Adequate open space at the end of the flow line will prevent ignition of underbrush, grass or trees, minimizing surface damage claims against the operator.

**8.** The mud pump should be immediately operable from the driller's console. If an emergency occurs where the well needs to be killed or the mud guns must be called into play, there can be no delay.

**9.** Precautions should be taken to locate valves and BOP control mechanisms for safe operation at all times.

**10.** Rig substructure should be well ventilated, either by natural convection or fans. A large fan can keep the air moving and blow away any

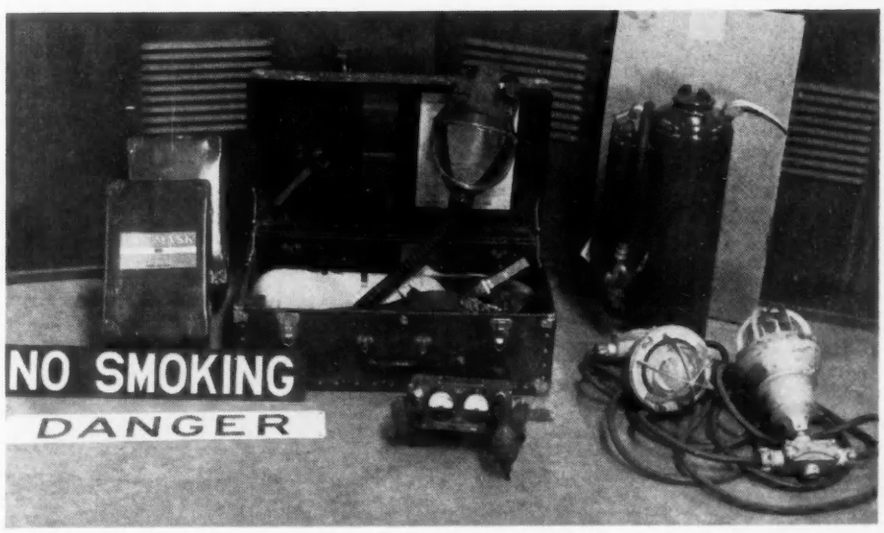


**FIGURE 2—Portable safety equipment carried by air drilling service companies include (rear, left to right) gas masks, self-contained breathing apparatus, and chemical type fire extinguishers. Front (left to right) are warning signs, gas detection device and vapor-proof night lighting.**

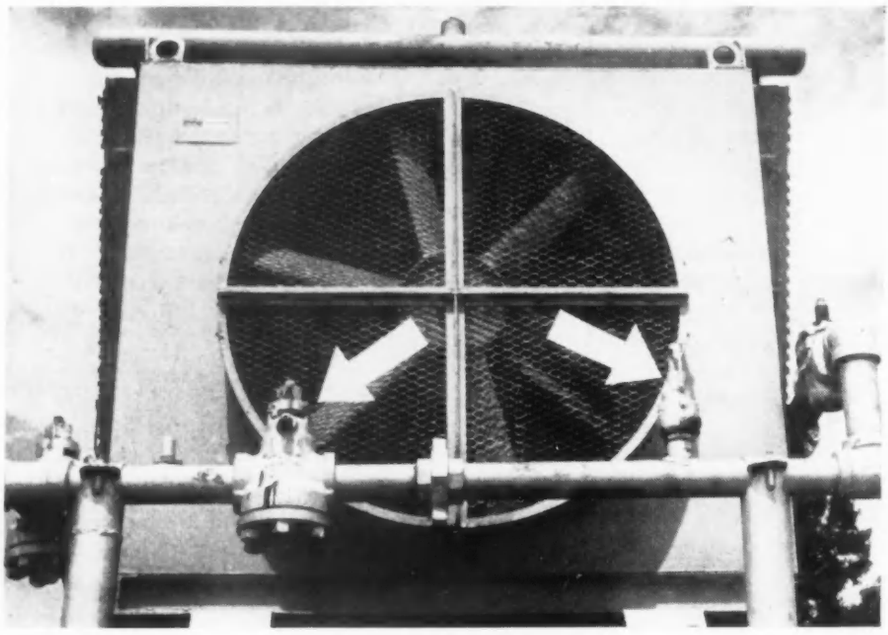

**FIGURE 3—Compressor safety features should include high-pressure valving (left arrow) and pop valves (right arrow). The air cooler shown will keep temperature limits of the air stream to the standpipe safely within the limits of rotary hose in good condition.**

unwanted gases. A squirrel cage type blower, installed on the discharge line, uses a suction to remove and prevent gas accumulation caused by leakage around the rotating head.

**11.** Vapor proof night lighting (Figure 2) is recommended for both rig and compressor battery.

**12.** Spark proof exhausts are also recommended for all engines in a "No Smoking" area.

**13.** Firefighting equipment usually consists of chemical type (Figure 2) fire extinguishers. Two should be handy on the rig floor, one of which should be by the driller. Chemical type fire extinguishers are also located in the compressor area, supplied by the air drilling service company.

**14.** Drilling crews with no previous air or gas drilling experience should be thoroughly trained in the proper technique for making connections. It is important that the standpipe gage be a zero before breaking out the kelly.

**15.** Equally important is the necessity for an operational kelly cock so that pressures can be contained in the drill pipe. Temperatures or other properties of the high pressure air stream should not affect a rotary hose in good condition.

Responsibility for safe operating conditions in the compressor area rests with the air service company. Drilling operations have been suspended when unsafe practices by an air drilling service caused revocation of the drilling contractor's insurance. Operator and contractor representatives should satisfy themselves that safe operating procedures are practiced by the air service company.

Unauthorized personnel should not be in the compressor area. Supervision and maintenance of the compressors should be solely the responsibility of a qualified compressor technician. Operations and maintenance of chemical or solids pumps used during water control operations should also be under the supervision of the air drilling service company personnel.

Piping and valves on compressors and boosters generally have a 100 percent safety factor. A booster capable of taking air or natural gas to 1500 psi should have 3,000-pound test fittings and valves.

**16.** Care should be taken to see that valves and piping from the compressor area to the rig are of adequate rating for the pressures which may be used during line testing or drilling.

Only double acting compressoss are considered safe for compressing natural gas, since the air cylinder is effectively separated from the crankcase. Single acting compressors normally produce a great deal of oil into the air lines.

In air drilling above 300 psi, double acting compressors using high flash point oil for lubrication should be used.

High operating pressures also call for demisters between stages of compression to separate out oil which may have escaped into the cylinder. After coolers and inter-coolers are generally desirable to restrict air temperatures well within rotary hose limits.

**17.** First aid treatment is only for injuries of a minor nature. In the event of a serious injury or burns, services of a physician should be secured in addition to administering first aid.

**18.** Responsibility for accidents in the past has been traced in almost every instance to personnel carelessness and inattention to safety recommendations. Rigid enforcement of the prohibition against bringing cigarets, lighters or matches on the rig floor will eliminate this source of hazard. Receptacles for these items should be provided for visitors. A warning sign might also be displayed in the change house.

**19.** If any toxic cases are expected in the subsurface or if silicon tetrafluoride gas is to be used in a water shutoff treatment, proper respiratory equipment should be on hand. Air drilling service companies licensed to provide the silicon tetrafluoride treatment will supply the recommended self-contained breathing apparatus (Figure 2), rubber gloves and protective clothing. Personnel not properly protected, or those not connected with this specialized operation, should be kept out of the immediate work area.

### DRILLING CHECK LIST

**1.** Is blowout preventer operating properly?

**2.** Is dust collecting in substructure or cellar area? If so, why?

**3.** Is any reading obtained on the gas detection device on the rig floor or cellar? (During gas drilling or while hole is making any gas.)

**4.** Have stripper rubbers been greased? Are stripper rubbers in good condition or is replacement advisable?

**5.** Are all lines still leakproof?

**6.** Is mud pump immediately operable? Pits full?

**7.** Is hole being circulated adequately prior to breakouts?

**8.** Are crewmen certain of breakout and connection procedures?

**9.** Are floats in good operating condition?

**10.** Are good housekeeping procedures being followed?

**11.** If supplies or third party services are expected, have crewmen been reminded of appropriate additional safety observances?

**12.** Are special tools or systems, such as closed circuit drilling, being used which require specific safety procedure instructions?

**13.** Are all personnel satisfied with safety conditions or are there questions remaining to be answered?

**Drilling check list discussion.** Who shall perform what safety checks should be delegated for each tour. It may be advisable, from time to time, for the toolpusher or air drilling technician to accompany the assigned crewmen on inspection and safety checks.

**1.** At least once each tour the blowout preventer should be tested. Some operators and contractors insist on four-hour test intervals while circulating natural gas or while the hole is making gas.

**2.** Dust collecting in the substructure area may indicate a leak which should be corrected.

**3.** A portable gas detector (Figure 2) should be used to test the atmosphere in the cellar and on the floor. If the hole is making gas or gas drilling is in progress, the presence of gas in the cellar is hazardous. Additional ventilation may be in order, as well as preventive maintenance of the blowout preventer.

**4.** Frequent greasing of the rotating blowout preventer stripper rubbers is necessary. The stripper rubber should be checked and replaced if any leaks develop. The stripper rubber should be sized so that it is capable of accommodating all tool joints and drill collars so the complete drill string may be passed through it.

**5.** Lines should be checked for leaks. A film of dust or vapor may indicate necessary repair. It cannot be emphasized too often that all pressure should be bled off prior to work on lines.

**6.** Each driller should assure himself that the mud pump is in operating condition and a supply of mud or water is ready.

**7.** Before making a connection, the hole should be circulated to clean out cuttings from top to bottom. With uphole velocities of approximately 3,000-5,000 feet per minute during air drilling operations, circulating the hole clean is a matter of moments. Once the air pressure is cut off, formation cuttings will start to drop back to the bottom of the hole, rather than remain suspended as within conventional drilling liquids.

**8.** The driller should make sure that the standpipe pressure gage is at zero before crewmen break out the kelly.

**9.** During trips, the float should be checked before going back to bottom with a new bit. If high pressure gas is expected, two floats should be installed.

**10.** Good housekeeping procedures should be followed at all times as a normal operating safety habit.

## About the Author

**Gordon Jackson** is president of Well Completions, Inc., located in Denver. Prior to joining Well Completions, Inc., he spent 20 years with Eastman Oil Well Service Company working in the major petroleum provinces of the western United States, Canada, and a number of overseas areas. Jackson is an engineering graduate of the University of California and holds patents on various tools and methods, principally concerned with drilling and production. Jackson has authored and presented several papers on air/gas drilling before technical and professional groups in the United States and Canada. He is a member of the API, the Society of Petroleum Engineers of AIME, and the Nomads.

**11.** If deliveries of fuel or other supplies are expected, crewmen should be reminded of any hazards. Perhaps the greatest hazard to the safety of the crew and equipment is any inattention to recommended safety procedures on the part of strangers or visitors to the rig.

**12.** When drilling with natural gas in a closed system, demisters should be installed ahead of the compressors. All portions of the closed circuit should be connected to an exhaust stack for relieving pressure in the entire system.

Company personnel accompanying or responsible for operating special tools or services should be requested to render safety recommendations.

**13.** Crewmen should be urged by supervisors to ask questions regarding safe operating procedures. The greater the knowledge of every individual on location, the greater the chance of individual safety responsibility being effective.

Supervisors will recognize that the purpose of safety, to assure rapid, trouble-free progress of the drill, can be assisted by passing on their experience. When drilling with gas, for instance, what drilling practices can implement the maintenance of safe conditions? When tripping pipe while the hole is making gas, what might a sudden drop in gas flow through the discharge pipe mean? It could mean that a bridge had formed below the bit which would suddenly be dislodged and blow up the hole as the pressure built up below it. It could mean that the gas zone had been exhausted. Proper action, based on experience and training, will enable supervisors to reduce this or similar hazards.

**Future safety records.** Safety, through briefings, drills, delegation of responsibilities, and discussion, should receive the wholehearted support of the three managements. Safety can be implemented in the field by supervisory personnel representing these managements; each supervisor being aware of mutual obligations and responsibilities. Under these conditions, new records for air drilling safety are certain to be established in the future.

BIBLIOGRAPHY

[1] Fuller, L. S., "Hazards of Drilling With Natural Gas," WORLD OIL, 138, No. 1, 121-122 (1954).
[2] Petty, J. K. "Interpretation of Air-Drilled Samples," *Petroleum Engineer* 32, No. 1, (1960).

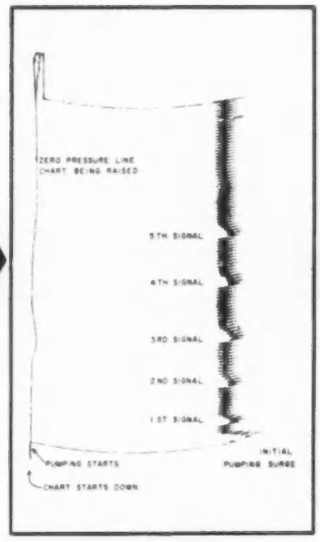


FIGURE 1

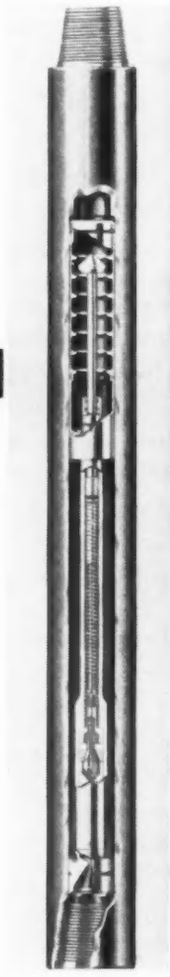

FIGURE 2

**Reproduction of actual chart (Figure 1) shows series of pulses which indicate hole angle. Note that after initial pumping surge (bottom of chart), the five signals come through as clear-cut, easily detected pulses. In this particular example, depth of hole was 8,898 feet; drift angle was 2½ degrees (five pulses with each representing one-half degree of deviation) and downtime for the reading amounted to only approximately 60 seconds. Cutaway drawing (Figure 2) shows interior of drift indicator device. Positioned in sub just above bit, it signals, by pulses transmitted through the mud stream, the hole angle to a recorder at the driller's position (extreme left).**

# New drift indicator cuts drilling time

**Faster penetration, fewer bits and straighter hole results form this tool which signals hole angle to surface**

**By Gilbert M. Wilson**
Western District Editor, WORLD OIL

A SIMPLE NEW signaling instrument determines the angle of a bore hole from vertical as often as needed.

The device normally is put in a 7-foot sub having the same OD as the drill collar and is positioned immediately above the bit. Readings are obtained by lifting the bit off bottom, stopping rotation and—with the pipe still—shutting down mud pumps for 45 to 60 seconds. Then, pumps are started, and a series of pulses, or pressure surges, arrive at the surface through the mud stream. The number of pulses indicates the degree of hole angle.

The pulses, each representing one-half degree of hole angle unless shop altered to satisfy any other field requirement within the 10½-degree maximum recordable angle attainable, are recorded on a 3-inch by 5-inch chart located near the driller's position.

A reading may be taken as often as desired. Usually, it is taken each time a single is added or at each round trip.

**Advantages of new tool.** Following are some of the additional advantages of the signaling tool:

- Deviation is obtained quickly, with but one or two minutes required for a typical drift determination.
- Faster drilling can result since

more weight can be put on the bit if deviation is known constantly.

- Driller or other crew members can learn to handle and interpret the tool and charts in one tour.
- Drill string need not stand without circulation for more than a minute or two while reading is being taken.
- Tool does not restrict flow of fluid or lost circulation materials.
- Driller can quickly read the chart, count the pulses, and divide by two (if tool is set for ½-degree increments) to determine hole deviation in degrees from vertical.

Under field tests for a year in California, the all-mechanical indicator does not affect pumping or handling of mud or lost circulation material. On tests in wells ranging to 11,700 feet, an increase in penetration rate has been reported. This has been due to the ability to increase weight on the bit and hold it to obtain maximum penetration rate since the angle of drift is known and since deviation can be detected before it became serious. In addition, the number of bits required has been reduced in the 12 or more field tests conducted so far.

**Drilling contractors' experience with new tool.** In the Tejon-Wheeler Ridge area of southern San Joaquin Valley in California, a basalt zone ranging from 600 to 1,800 feet thick frequently is found at depths below 9,000 feet. This material is dense and cuttings settle out fast so that when circulation is stopped for very long, drill pipe frequently becomes stuck. Therefore, while drilling this zone, contractors either stop taking surveys or else take them infrequently, with the result that some holes have kicked out as much as 16 degrees from vertical between surveys.

One contractor operating in this valley area who used this new indicator reported using eight bits fewer than he normally would have used. He said this was the result of not pulling green bits and of maintaining higher penetration rates without fear of increasing deviation. This contractor took a deviation survey as frequently as every 10 feet while drilling the basalt zone.

A toolpusher on another well reported that at 2,200 feet the hole was an estimated 700 feet deeper than it would have been had this tool not been used.

Another drilling contractor reported that use of this instrument led to sufficient top hole savings to pay its rental "several times over" based on his previous experience in drilling adjacent wells.

As a drilling tool, this indicator offers cost cutting possibilities in problem areas:

- Where it has been impractical to run surveys in the first 5,000-7,000 feet of hole in several Gulf Coast areas due to serious caving problems.
- In areas, such as some Rocky Mountain regions, formations dip steeply and necessitate drilling with a packed hole, for example, 11¼-inch collars inside 12¼-inch hole. Such a hole must be surveyed frequently, for if not watched closely, deviation can increase rapidly up to 15 degrees or more. From 9 to 10 days usually are required in drilling to 3,200 feet and about 3½ days of this time is spent in surveying.

**How tool works.** Pressure surges in the mud stream which, by their number, indicate the amount of deviation from vertical, are produced by a series of restrictions in the tool. These restrictions, or signal rings, create a succession of pressure pulses in the mud stream. The number of pulses varies with the degree of deviation from vertical.

The pulses, or signals, usually have peaks ranging from 100 to 150 psi above the average pump pressure. Their duration—four to six seconds—makes them easily seen above even abnormal pump pulsations (Figure 1).

The new device generates a maximum of seven signals. Each signal represents an increment of angle of one-half degree. A single pulse on the chart, therefore, would represent an angle of from zero to one-half degree; two signals would indicate one-half to one degree; three signals one to 1½ degrees, etc. Seven signals would indicate an angle of three degrees or more.

A few seconds after normal mud pressure is reached, following the 45 to 60 second shutdown of the pumps, the first signal will appear at the surface. Remaining signals, depending upon the deviation, are transmitted at intervals of from 10 to 20 seconds. Seven signals, if there were that many, would arrive at the surface over a period of about two minutes after resumption of pumping.

It is not necessary to start up the pump immediately after the "quiet," or measuring, period. During that period, for example, the pipe could be picked up to make a connection, after which signals would be obtained with the start of pumping as drilling is resumed.

Referring to the cutaway drawing in Figure 2, the device comprises a liquid-filled instrument casing or housing and a plunger that tends to be extended longitudinally upward from the housing by spring action. The plunger top has a head, or enlargement, that traverses a series of annular restrictions, or rings, which produces the pressure surges in the mud stream. The instrument housing has an equalizing diaphragm which permits displacement of the confined instrument liquid so the combined volume of the housing and the exposed portion of the plunger remain constant throughout the operation.

When mud pumps are stopped and downward flow of drilling fluid ceases, the plunger extends along the series of restrictions to whatever degree permitted by a small pendulum (visible near bottom of tool shown in drawing) which moves along a series of graduated stop shoulders.

Each successive pendulum stop shoulder represents an increment of deviation angle. These increments of angle can be varied as desired, by adjustments before tool is run in the hole.

When mud pumps are started and drilling mud flow resumes, the force of the mud stream against the plunger head drives the plunger slowly back to its normally retracted position. As the plunger head passes each restriction, a pressure surge is created. The number of surges will be in accordance with the stopped position of the plunger and the corresponding signal rings traversed by it.

Normally, a deviation measurement can be obtained each time the pumps are started after any pause, such as, to add a single. In such a case, down time may amount to less than 45 seconds. Drill pipe may be run in the hole while signals are continuing. The only precaution to take is in not lowering too fast since unwanted pressure surges might be created. —**The End**

**A World Oil Interview** — *with* — **LAWRENCE J. O'CONNOR**
**Oil Import Administrator**
**Washington, D. C.**

# A new look at oil imports

## The Interior Department's new oil import administrator gives a candid rebuttal to criticism of the mandatory program

**By Don E. Lambert**
Associate Editor, WORLD OIL

*Editor's note: Reductions in Middle East crude prices, tight proration schedules and dissension over residual imports are keeping the U. S. mandatory oil import program under constant fire from oil, coal and consumer groups.*

*Arguments presented by some of these special interest groups indicate that a certain amount of confusion still exists concerning the import formula—and its purpose.*

*To place the program in its proper perspective and to answer questions that have been raised about the program, World Oil conducted the following exclusive interview with Oil Import Administrator Lawrence J. O'Connor, Jr.:*

**Q** *Mr. O'Connor, do you foresee any changes in the mandatory oil imports program during 1960?*

**A** The Proclamation requires that the mandatory oil import program be kept under constant surveillance and, of course, we are always seeking means whereby the administration of the program can be improved. In the past as needs have developed, alterations have been adopted. We shall continue to pursue the policy of keeping the program responsive to requirements as they develop, but at this time I do not foresee any changes in the program during the remainder of 1960.

**Q** *There is some confusion as to the factors used in setting import quotas. Would you explain the formula you are now using?*

**A** In Districts I-IV the crude oil, unfinished oils and finished products other than residual to be used as fuel allocation, is equal to 9 percent of the Bureau of Mines projection of total demand for the allocation period. Within this over-all limitation, importers may elect to take 10 percent of their allocations of crude oil in the form of unfinished products, and may import finished products other than residual at the level established in 1957.

The residual fuel oil allocation levels are established by the Secretary of the Interior. The principal basis used in establishing the allocations is the actual level of imports during 1957, the base year of the program. Other factors such as the level of industrial activity, the inventory position, and weather, are also considered.

In District V the over-all import allocation level for crude oil, unfinished oils and finished products for a specific period is established on the basis of the difference between domestic supply and total demand as projected by the Bureau of Mines.

Within the total allowable imports the importation of finished products cannot exceed the quantity of these products that were imported in 1957, and the over-all established level of the crude oil allocation. For the purpose of establishing District V allocation levels, overland "exempt" imports are treated as domestic supply.

**Q** *What was the average daily import quota for crude oil and refined products during the first six months of 1960?*

**A** The average daily import quota for crude oil and refined products for the first six months of 1960 is as follows:

**Districts I-IV**

| | | |
|---|---|---|
| Crude (and unfinished oils) | 718,941 | barrels per day |
| Residual fuel oil | 490,934 | " |
| Finished products | 76,631 | " |

**District V**

| | | |
|---|---|---|
| Crude (and unfinished oils) | 220,095 | barrels per day |
| Residual fuel oil | 0 | " |
| Finished products | 6,753 | " |

**Puerto Rico**

| | | |
|---|---|---|
| Crude (and unfinished oils) | 83,231 | barrels per day |
| Residual fuel oil | 1,644 | " |
| Finished products | 3,064 | " |

**Q** *What was the ratio of imports to demand during this period? How does this compare with the 1954-1959 percentages?*

**A** The ratio of imports to demand (exclusive of bonded bunker, manufactured and re-exported, and military re-export which are not included in the import control program) during the period 1954 through 1959, and the first half of 1960 is as follows:

**Districts I-IV**

| YEAR | Demand Barrels Per Day | Imports Barrels Per Day | Ratio | Imports Less Residual Barrels Per Day | Ratio |
|---|---|---|---|---|---|
| 1954 | 6,959,000 | 926,000 | **13.3%** | 640,000 | **9.2%** |
| 1955 | 7,567,000 | 1,069,000 | **14.1%** | 727,000 | **9.6%** |
| 1956 | 7,917,000 | 1,152,000 | **14.6%** | 795,000 | **10.0%** |
| 1957 | 8,083,000 | 1,170,000 | **14.5%** | 821,000 | **10.2%** |
| 1958 | 8,099,000 | 1,332,000 | **16.4%** | 958,000 | **11.9%** |
| 1959 | 8,352,000 | 1,347,000 | **16.1%** | 869,000 | **10.4%** |
| 1960 | 8,678,000* | 1,350,000* | **15.5%** | 859,000* | **9.9%** |

* Estimated.

**District V**

| YEAR | Demand Barrels Per Day | Imports Barrels Per Day | Ratio |
|---|---|---|---|
| 1954 | 1,154,000 | 57,000 | **4.9%** |
| 1955 | 1,285,000 | 101,000 | **7.9%** |
| 1956 | 1,279,000 | 193,000 | **15.1%** |
| 1957 | 1,249,000 | 267,000 | **21.4%** |
| 1958 | 1,274,000 | 210,000 | **16.5%** |
| 1959 | 1,375,000 | 257,000 | **18.7%** |
| 1960 | 1,381,000* | 276,000* | **20.0%** |

* Estimated.

***". . . the (import) levels were set with full knowledge of their impact both on the domestic industry and upon foreign-supplying nations."***

**Q** *Representative George E. Shipley recently attacked the entire import program as one which "only stabilizes a rate (of imports) that already is excessive." Do you agree?*

**A** I cannot agree that the current rate of imports is excessive. The procedures under which the allocations are established were arrived at after a most searching examination of the entire question on the part of a special Cabinet Committee.

The program has the very definite objective of assuring the maintenance of a healthy and vigorous domestic industry capable of exploring for and developing reserves needed for national security. The operation of the program is constantly being measured against this objective.

I am sure there are segments of opinion which consider any import level excessive and others that would view any allocation regardless of size as insufficient. The levels established were set with full knowledge of their impact both on the domestic industry and upon foreign-supplying nations.

**Q** *Some groups say that current excessive crude oil productive capacity in the U.S. is due largely to excessive imports. Others say drilling of too many wells and the growing impact of natural gas on crude oil markets have influenced the domestic picture as much as imports, if*

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**Lawrence J. O'Connor, Jr.,** 45, was appointed Administrator of the Oil Import Administration of the Department of the Interior on July 1, 1960, by Secretary of the Interior, Fred A. Seaton.

A native of Tulsa, Okla., O'Connor spent most of his early childhood in Butler, Pennsylvania, and then returned to Tulsa where he graduated from Central High School. He received his B.A. degree from Rice University and a Master's degree in business administration from Harvard University.

He has served as director and vice president, Houston District, Independent Petroleum Association of America. He was chairman of the Tax Study Committee of that Association and on committees dealing with oil and gas supply and demand, natural gas, oil and gas productive capacity and economic and cost studies. He has served as director and vice president, Houston Chapter of the Tax Executives Institute.

**Lawrence J. O'Connor, Jr.**

O'Connor is a licensed certified public accountant in Texas. From 1938 to 1945 he was employed by the certified public accountant firm of Haskins and Sells, Houston. From 1945 to 1958 he was employed by the Goldston Oil Corporation of Houston where he advanced to vice president and treasurer. From October 1, 1958 to October 1959 he was self-employed as a consultant engaged in special studies and programs for future oil and gas exploration activities.

From October 15, 1959 to the time of his recent appointment, O'Connor served as Assistant Director of the Interior Department's Office of Oil and Gas.

***". . . It has not been demonstrated that a moderate reduction in import levels would necessarily contribute materially to stimulating development of more crude oil reserves in the United States."***

*not more so. Can you place these factors in their proper perspective?*

**A** It is doubtful that there is any "proper" perspective in a subject this complex. My job as you know is limited to administering the oil import program as prescribed by the President's Proclamation.

**Q** *To what extent are independent producers, small refiners and small petrochemical companies being affected by imports?*

**A** I presume your question refers to imports under the import control program. It is difficult to ascertain how the import program has a measurable effect on small petrochemical concerns, it may help them to a limited extent.

Independent producers are being assisted substantially by the program. Consider if you will, the situation they would face in the absence of some import controls.

The small independent refiners are aided in two ways: The program has tended to firm prices and the sliding scale method of setting individual allocations results in smaller refiners receiving a somewhat higher percentage of imports in relation to their refining runs than do larger refiners.

**Q** *Are there any plans to restrict Canadian and Mexican crude oil, natural gas and refined products imports?*

**A** Importation of natural gas is not controlled by Proclamation 3279. Therefore, the Oil Import Administration has no authority with respect to natural gas.

The Proclamation provides for overland shipment of crude oil and refined products which are produced from Canadian or Mexican crude. No changes are contemplated. Refined products which are imported by water or which are manufactured from other than Canadian or Mexican crude are subject to import restrictions. The Oil Import Administration is maintaining surveillance of Canadian and Mexican imports which are not subject to restriction.

**Q** *What is being done to quell the recent uproar over residual imports?*

**A** Primarily we are letting the facts speak for themselves. For the last seven months there have been some dire predictions of dangerously lowered inventories and a runaway price situation. In fact, prices have been relatively stable, and stocks as of June 30, 1960, were at satisfactory levels.

The Department has said many times in the past that there is no intention to administer the program in such a manner as to create artificial shortages and consequent hardship to normal consumers. On the other hand, everyone concerned must recognize that this is in fact, a control program.

**Q** *Rumors are that some Russian petroleum products are being imported into the U.S. via Sweden. Is this true?*

**A** We have no knowledge of any Russian petroleum products being imported into the U.S. via Sweden. The program does not restrict any foreign supply source. However, no importer has reported imports of Russian products.

**Q** *Would tighter import restrictions aid national security by stimulating the development of more crude oil reserves in the U. S.?*

**A** It has not been demonstrated that a moderate reduction in import levels would necessarily contribute materially to stimulating development of more crude oil reserves in the United States. A significant reduction in imports would have a material effect upon our present relations with friendly producer nations.

Therefore, we feel that the interests of national security are served best by a reasonable and balanced relation of imports to domestic demand. We feel that in the long run the program as presently administered will contribute more effectively to the principle that imports should supplement and not supplant domestic production.

**Q** *What are your opinions concerning the placing of tariffs on crude oil and refined products imported into this country?*

**A** The President's Special Committee to Investigate Crude Oil Imports considered the imposition of tariffs on crude oil and refined products into this country, but decided in favor of limitation in the form of absolute quotas.

The establishment of tariffs on any continuing basis would create many additional problems. A tariff at a rate low enough not to be exclusionary would permit at some point the importation of oil from some source countries and still exclude imports from others. A tariff that is not exclusive would not provide any positive control over imports. **—The End.**

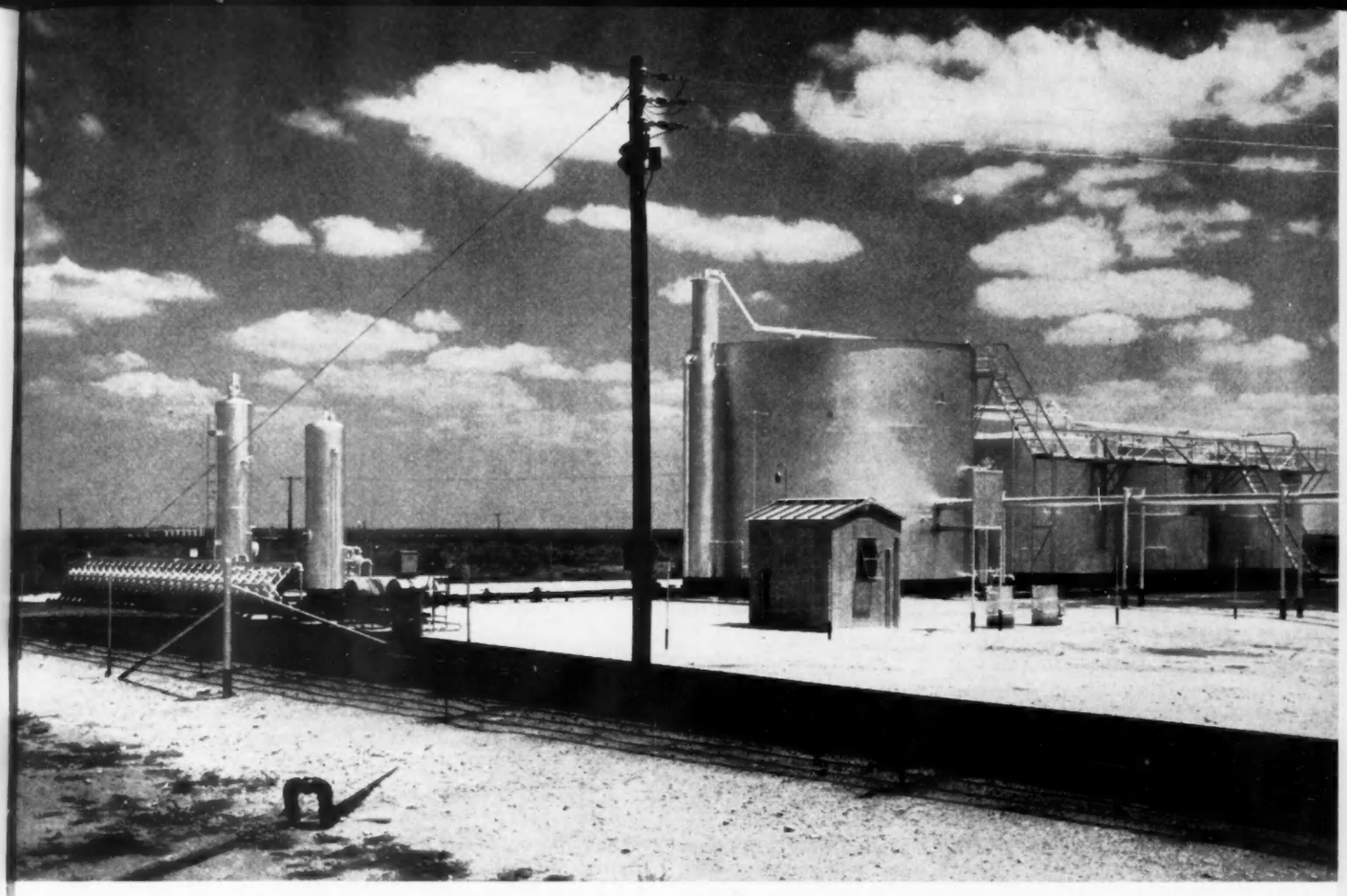


FIGURE 1—Gulf Oil Corporation's automatic tank battery in West Texas serves 74 producing wells. All crude is automatically produced, measured, treated and sold through the battery.

# How Gulf automated a 74-well lease in West Texas

## New installation designed for unattended operation from wellhead to pipe line. Features include complete automatic well testing facilities, LACT

**By Charles E. Golding,**
Assistant to the General Manager
Odex Engineering Company, Odessa, Texas

Gulf Oil Corporation has recently installed a new automatic tank battery in the West Texas area to serve 74 producing wells. All producing functions have been automated for unattended operation from wellhead to the pipe line. The installation, designed to handle San Andres crude, includes the following features:

- Automatic well testing (oil, gas and water) at remote satellite stations and at the central battery.
- Automatic well test data printout.
- Integrating gas meters record gas production in Mcf over a ninefold range of volumes.
- Central battery treating system for all production.
- Monitoring system for bad oil production.
- Shut-in devices for allowable attainment, electrical or pneumatic failure, custody transfer malfunction, etc.

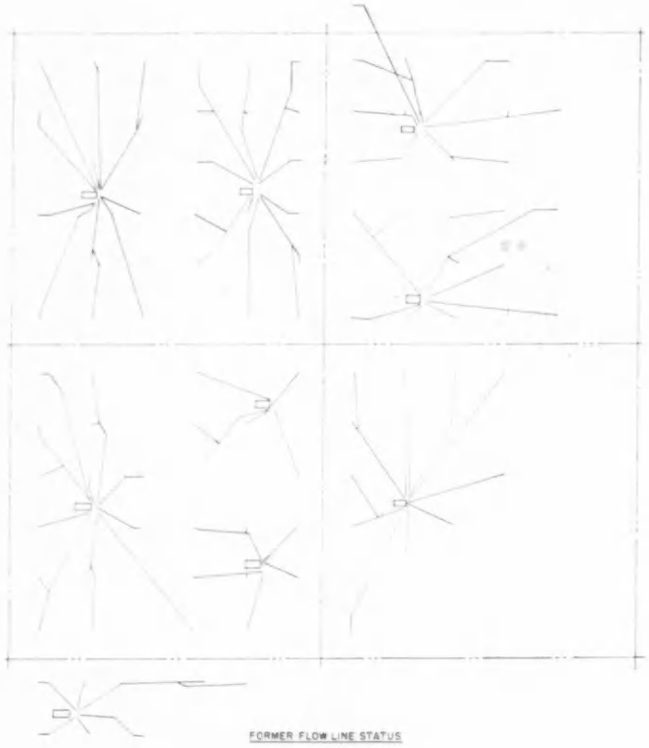



FIGURE 2

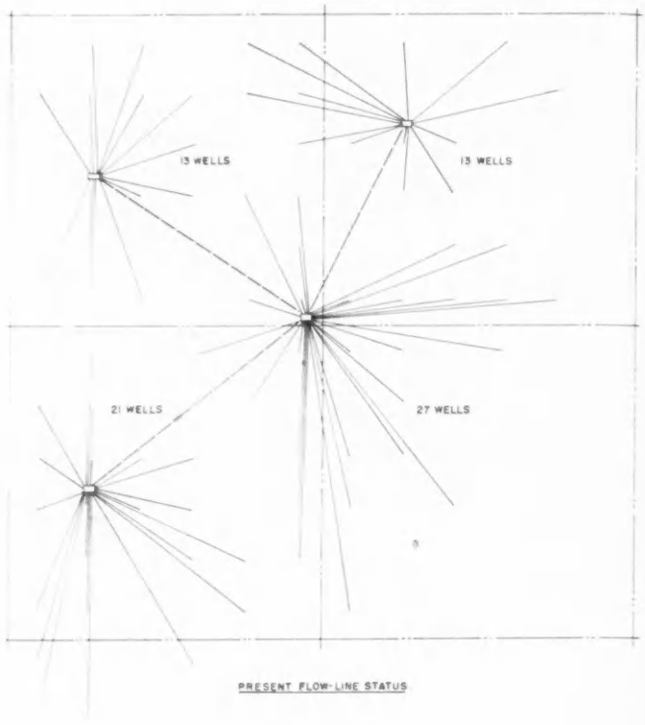



FIGURE 3

**Here is a comparison of the lease layout before and after automation. As shown in Figure 2, nine batteries were used to serve the lease before the automation project. Figure 3 shows the automatic lease. Three satellites and one central battery now serves the 74 producing wells.**

• Lease automatic custody transfer system.

**Gathering system.** All existing well flowlines were replaced with new plasticoated pipe and three existing battery sites were utilized for satellite stations. The central battery was installed at a new location. Seventeen wells are being pumped, and these are equipped with high pressure shutdown switches which are activated in the event of well shut-in at the test station. Figures 2 and 3 show the rearrangement of the flow lines.

**Testing facilities.** The operator normally desires at least one test per well per month, and if possible, of 24-hour duration. This necessarily limits the number of wells entering a test station to a maximum of 30, unless dual testing facilities are installed.

This particular installation employs two remote satellite test stations of 13 wells each, one of 21 wells and the central battery station of 27 wells. Each station is operated under local automatic control, and records its own test data.

Fluid from each well, as shown in Figures 4 and 5, enters a three-way, three-position diverting valve at the test station. A well scheduled on test by the well test control panel is diverted to the test manifold, and is routed to the test facilities. All other wells are diverted to the production separator, from which produced gas goes to sales and fluids go to the trunkline for entry into the central battery treating system.

The three phases of the well on test—oil, gas and water—must be metered separately and are routed through an indirect heater to the oil and water metering test separator. This vessel separates the phases, sending gas to the gas measuring facilities, and sending oil and water to their separate metering chambers. Here, fluid is measured by dumping of one barrel increments between high and low level float pilots which operate the proper diverting valves. Also, switches are actuated which send electrical signals to the well test control panel for data recording. A mechanical counter on the unit also registers for visual check of the operation of the automatic facilities. Fluids are recombined after metering, and are discharged into the main input stream of the remainder of the wells to the central battery treating system.

The gas testing facility is unique in that an integrating gas meter is employed to measure gas over a ninefold range of volumes. For accuracy of measurement it was desired not to exceed a threefold range for a given orifice plate. Therefore, two orifice runs were installed covering volume ratios of one to three and three to nine.

For testing of small quantities of gas, the run with the smaller orifice plate is used. When flow is such that 95 percent of pen travel of the gas meter is reached, electrical contacts are closed, diverting flow to the run with the larger orifice plate by means of solenoid operated diaphragm motor valves. Solenoid valves on the static and differential pressure lines divert them to the proper meter.

The integrating gas meter automatically solves the gas flow formula $V = C\sqrt{P\Delta p}$. The dual integrator extracts the square root of pressure and differential and the gear chain multiplier interprets this with other

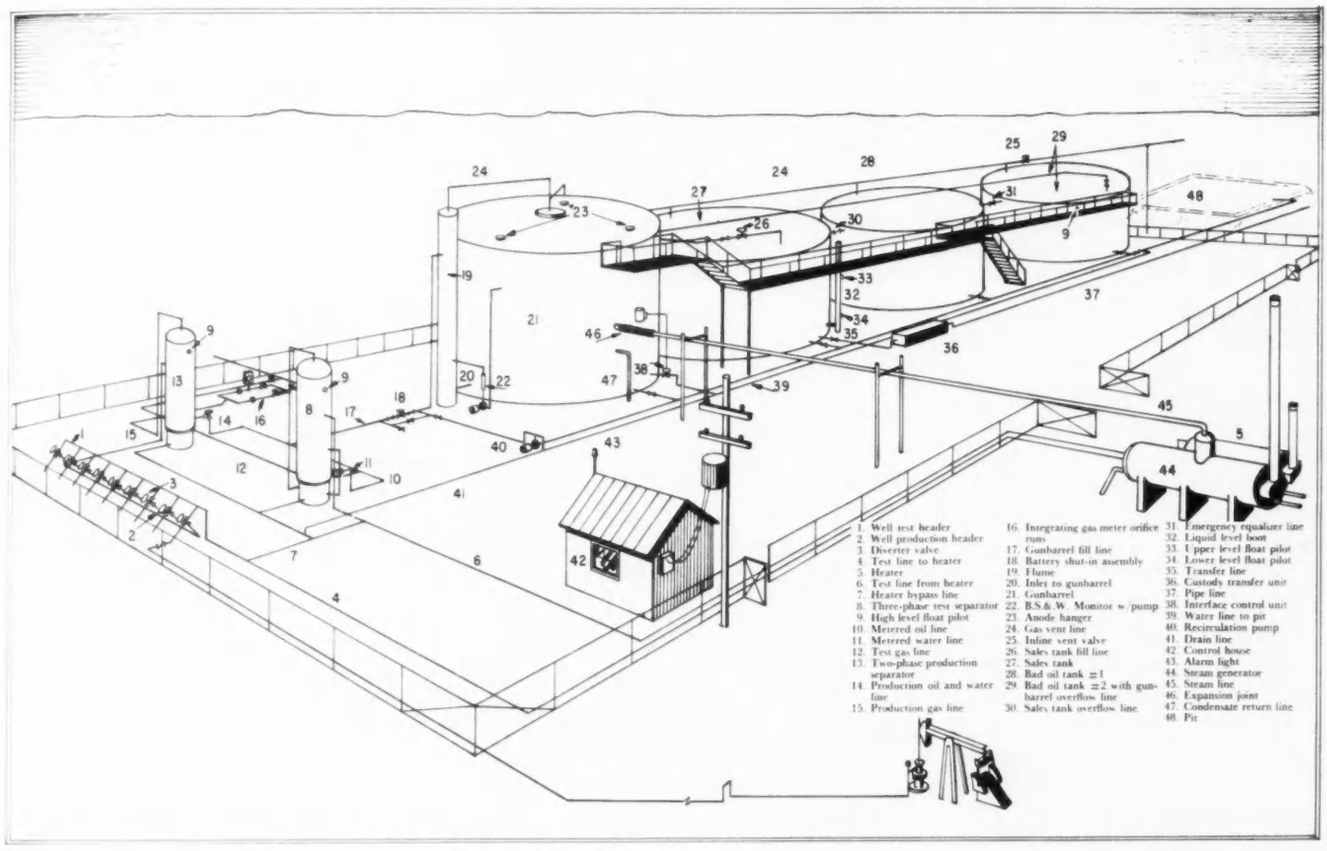

1. Well test header
2. Well production header
3. Diverter valve
4. Test line to heater
5. Heater
6. Test line from heater
7. Heater bypass line
8. Three-phase test separator
9. High level float pilot
10. Metered oil line
11. Metered water line
12. Test gas line
13. Two-phase production separator
14. Production oil and water line
15. Production gas line
16. Integrating gas meter orifice runs
17. Gunbarrel fill line
18. Battery shut-in assembly
19. Flume
20. Inlet to gunbarrel
21. Gunbarrel
22. B.S.& W. Monitor w/pump
23. Anode hanger
24. Gas vent line
25. Inline vent valve
26. Sales tank fill line
27. Sales tank
28. Bad oil tank #1
29. Bad oil tank #2 with gunbarrel overflow line
30. Sales tank overflow line
31. Emergency equalizer line
32. Liquid level boot
33. Upper level float pilot
34. Lower level float pilot
35. Transfer line
36. Custody transfer unit
37. Pipe line
38. Interface control unit
39. Water line to pit
40. Recirculation pump
41. Drain line
42. Control house
43. Alarm light
44. Steam generator
45. Steam line
46. Expansion joint
47. Condensate return line
48. Pit

**FIGURE 4—This schematic drawing shows details of central battery. All crude is sold through the central installation.**

values into units of one Mcf of gas. Since constant C is a function of the size of the orifice plate bore, a separate multiplier must be used for each run employed, and must be geared for proper interpretation of the signal fed into it. The output of each multiplier is identical—one electrical impulse per Mcf—and is printed out on the well test panel recording chart.

Therefore, it is not necessary that the multiplier be identified, or that it be known which orifice run metered the gas.

The well test control panel at each station automatically controls the testing of each well in sequence. A pre-set timing clock controls the length of test, normally 24 hours. Wells that are not to be tested for any reason are manually switched out of test sequence when the test program is set up and are by-passed. Data is printed out in digital form each hour, at the end of a test period, or on demand if desired. Oil and water are registered in barrels, and gas in Mcf. Wells are identified by actual well number. This information

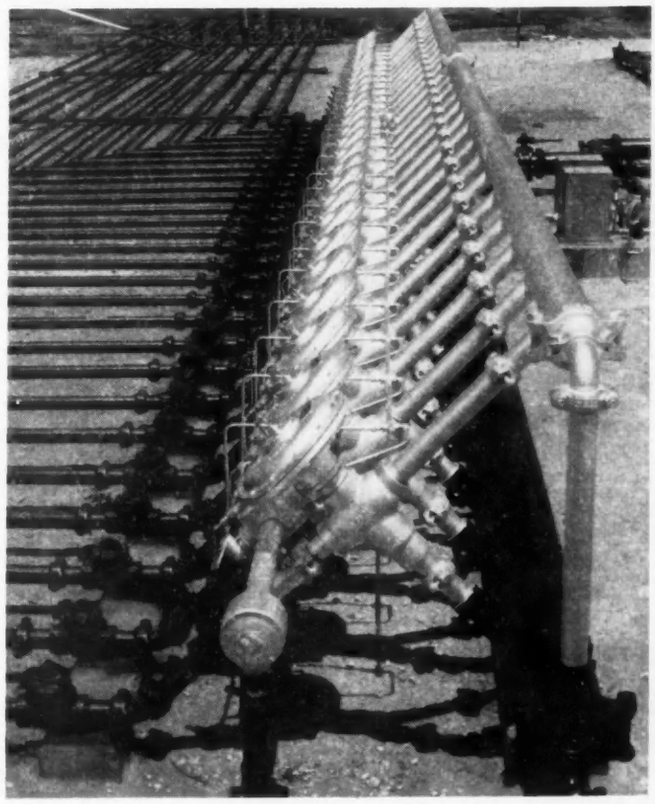


**FIGURE 5—Three-way, three-position diverting valves mounted on the inlet manifold are used for automatic well testing.**

is printed out at the beginning of each test (Figure 6).

Automatic lease shut-in is executed by the control panel in the event of a high level condition, by cutting off power to the solenoid operated three-way, three-position diverting valves. In the event of power failure, all functions are fail safe and no data is lost.

**Central battery treating system.** A great deal of consideration was given to the type of treatment to be employed at the central battery. Although treatment of San Andres crude is not difficult from the standpoint of emulsion breaking, problems do arise from paraffin deposition and corrosion.

The system handles approximately 5,000 bpd. Thus, it is essential that downtime be kept to an absolute minimum to avoid loss of production. A system was decided upon employing a steam generator and a 3,000 barrel capacity, 30-foot x 24-foot high gunbarrel (Figure 7).

Crude from the satellite stations and the central battery station enters a flume, or solution-gas separator, prior to entry into the gunbarrel. Gas is vented and the fluid enters the gunbarrel at ground level under a spreader.

The spreader, built of redwood and connected by monel fasteners, is 20 feet square and is supported two feet off the bottom of the gunbarrel. It also supports the cast iron steam coil assembly above it.

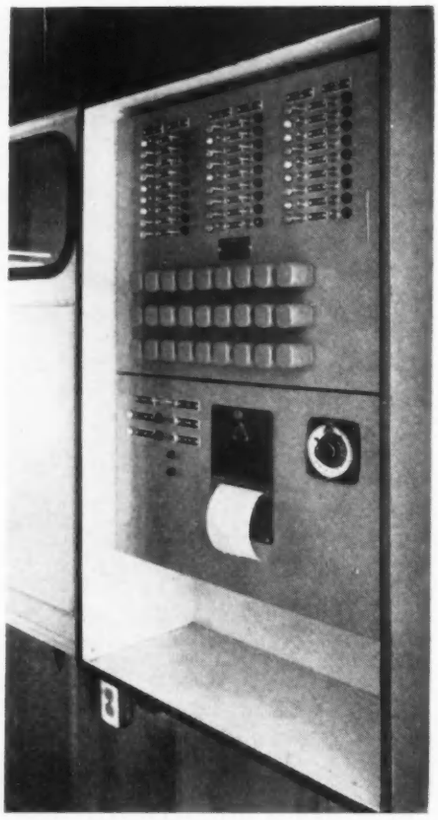


**FIGURE 6—Well test control panel includes a printout recorder. Each well is indentified by actual number and test data are printed out digitally.**

The cast iron coil assembly has over 1,000 square feet of heat transfer area and is composed of specially cast sections bolted together with monel bolts. A water wash section is maintained by an interface controller in the lower 10 feet of the vessel. This is sufficient height to provide a water level above the steam coil assembly.

Entering crude is diverted to the edges of the spreader and flows upward, through the water section outside the coil area. This arrangement does not allow direct contact of the crude with the steam coils, and minimizes coil corrosion and sedimentary deposition. Heat is transferred from the coils to the water bath and then by natural convection of the water to the crude rising around the edges of the spreader. Clean oil then discharges from the gunbarrel into the sales tank.

Although coils are constructed of cast iron, they are eventually deteriorated by the aggressive action of the fluids present. Thus, a cathodic protection system was installed. Three sacrificial magnesium anodes were hung in the water wash system 120 degrees apart. The entire inside surface of the steel gunbarrel is coated with a twenty mil coating of coal-tar epoxy resin.

The steam generator is capable of delivering 5,000,000 btu per hour. Steam is delivered to the gunbarrel through an eight-inch insulated line and condensate returns through a four-inch line. A thermostat on the

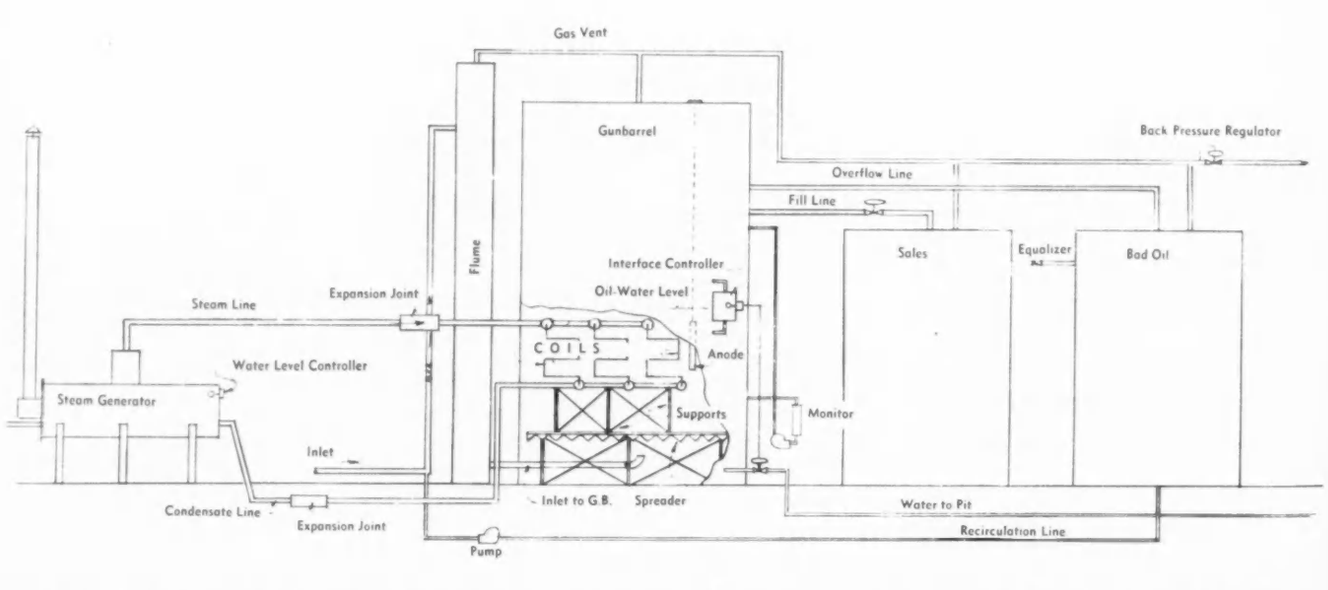



**FIGURE 7—This schematic drawing shows the treating system used on the central battery. The suspended anodes protect the steam coils.**

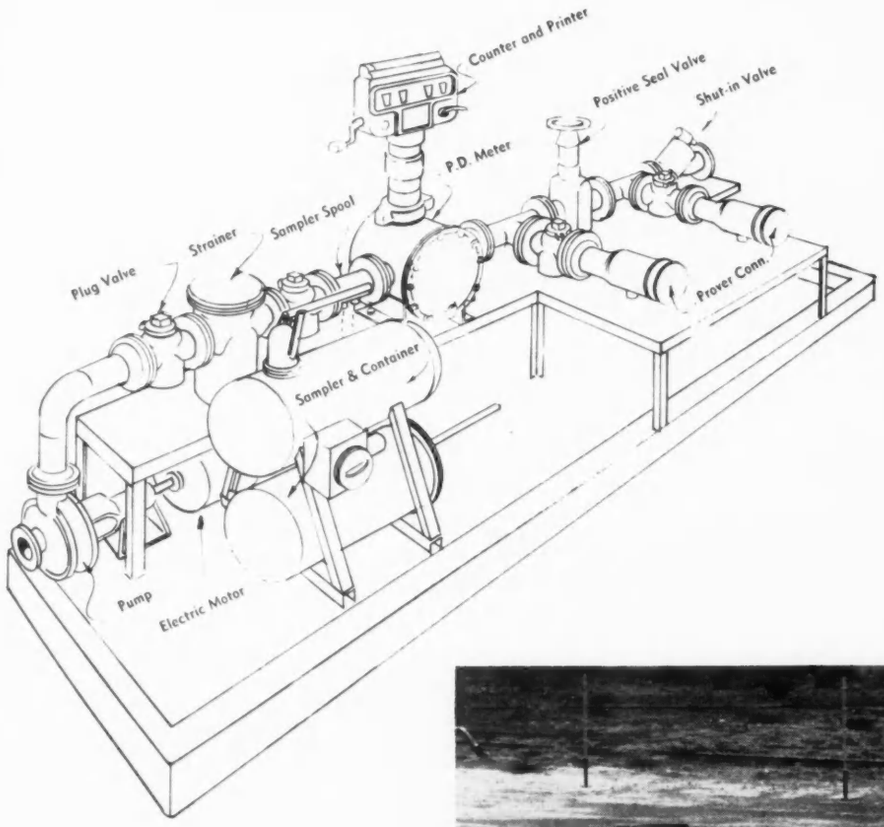



FIGURE 8

**This skit-mounted LACT unit handles all oil produced on the lease. Figure 9 shows the actual installation.**

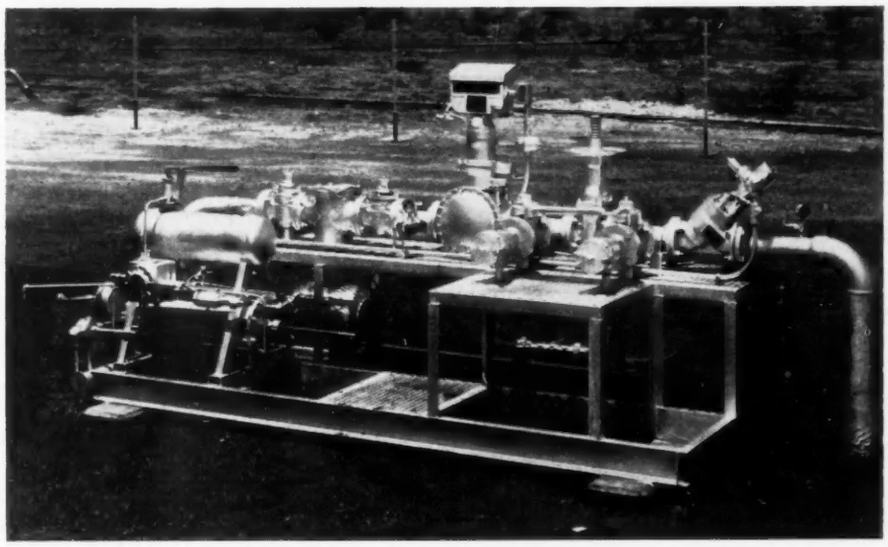


FIGURE 9

gunbarrel regulates the steam demand to maintain a pre-set temperature in the water bath, but can be overriden by the controls on the generator to prevent exceeding safe operating limits.

**Crude oil monitoring system.** In normal operation, saleable oil reaches a spillover point in the gunbarrel and passes to the sales tank. A small line at the spillover line elevation (19-feet) delivers a side stream to a pump which runs it through a capacitance probe type BS&W monitor. If the monitor detects a water content in excess of pipe line specifications, it closes a valve on the fill line to the sales tank.

When this condition exists, the gunbarrel continues filling until the oil is clean and normal operation is resumed automatically by the monitor. If the oil remains "bad," liquid level will rise to a second spillover point, and production will be directed to one of two "bad" oil tanks. Production then continues into these tanks until the monitor detects good oil or the tanks fill. If the "bad" oil tanks are filled, a high level float pilot shuts the lease in.

Manual recirculation back through the gunbarrel then is necessary. Automatic recirculation could be provided, but it is assumed that for the amount of time required for the system to shut-in, some malfunction of equipment must have taken place which would require human attention.

The monitor controls are built into the custody transfer control panel for convenience. Panel lamps indicate whether or not oil is clean, and an adjustable time delay prevents a momentary slug of bad oil from diverting the flow. An adjustable water percentage setting determines the amount of water allowed to be present under normal operation.

**LACT system.** A vertical pipe or boot, is attached to the 1,000-barrel sales tank and its fluid level is equalized with the tank. Upper and lower float pilots on this boot regulate transfer of oil to pipe line. When the level in the tank reaches the upper float pilot, the custody transfer pump begins delivering oil to pipe line. When the level recedes to the lower float pilot the pump stops. By mounting the pilots on an outside boot, they are accessible for maintenance and height alteration with a minimum of interruption to the system.

During sales, oil is delivered to the transfer pump which runs it through a positive displacement dual rotor type of meter and into the pipe line (Figure 8). A strainer is mounted immediately upstream of the meter to remove foreign material, and a combination back pressure and shut-in valve is located downstream to maintain back pressure on the meter to prevent solution gas breakout before or during metering.

A proportional-to-flow type sampler moves a small fluid stream past a solenoid valve and re-injects it back into the main stream. An electrical impulse, delivered every 10 barrels by

the meter to the solenoid valve, diverts a small sample into a pressurized sample container.

The positive displacement meter is calibrated once a month with a master meter of known accuracy, and any necessary correction adjustment is made on the calibration device. An automatic temperature compensator corrects volumes to 60° F.

The pulser, previously mentioned, sends an impulse to the sampler every 10 barrels. Another transmitter sends a signal to a remote pre-determining counter in the control panel. This counter is pre-set for the monthly production allowable and when it counts back to zero, the electrical contact to the transfer pump motor is broken.

A third pulser in the meter head shuts in the unit if the last gear of the meter counter fails to revolve during transfer. This prevents transfer of unmetered oil to pipe line in the event of counter failure. A ticket printer in the counter head prints initial and final readings of the meter for a written record of sales. Pipe line seals make the entire unit tamperproof.

The combination back pressure—shut-in valve prevents backflow of oil from the pipe line during shut-in, in addition to the back pressure function mentioned above.

In the event of custody transfer shut-in, if the sales tank continues to fill, fluid reaches a spill-over line to the bad oil tanks. A check valve prevents back flow. When the bad oil tanks are filled, a high level float pilot shuts the lease in. This allows use of the bad oil tanks for additional storage to prevent loss of production. The bad oil may be diverted back into the system manually when desired.

The custody transfer control panel is located remotely inside a weatherproof metal building, along with the well test control panel. It controls most functions of treating, monitoring and custody transfer systems, although some safety features are direct acting and only send it a back indication. The BS and W monitor controls are built-in and indicate condition of the oil. A graphic representation of the battery indicates schematically the status of all functions by means of indicating lamps.

**Advantages of automated battery.** The pros and cons of oilfield automation are as varied as the peculiar situations existing on the individual leases themselves. However, economics dictate the extent to which a field should be automated.

Labor saving is a vital factor in influencing an operator of the logical course of action, but it is by no means the sole consideration. Properly designed and installed automatic batteries allow unattended operation, and require only routine maintenance of equipment and periodic pickup of printed out data charts. Inasmuch as local conditions determine equipment costs versus labor saved, no cut and dried formula can be followed. Rather, an economic analysis must be run, and it must take into account many things other than direct labor savings.

Haphazard practices are eliminated. Greater accuracy of test data allows better scheduling of well workover procedures. Performance data of a particular well can be incorporated into a workover program designed for maximum production efficiency.

Of critical concern is the LACT unit. The particular battery described employs a positive displacement meter for sale to the pipe lines company, but many others utilize a positive volume tank, filling and dumping periodically, and recording the amount of crude oil transferred. Either system, achieves an accuracy beyond manual tank gauging methods. In addition, the sampling system, completely automatic and proportional to the volume of crude oil delivered, has definite advantages over thiefing of a tank.

Another consideration of automating a field is that of replacement of existing bad order equipment. This is especially applicable in corrosive areas where replacement is frequent. Often, existing equipment must be replaced entirely and the extent and future life of the field can be accurately evaluated. In this situation, the operator is not limited by adaptation or duplication of present equipment and layout.

The extent of automation influences the physical layout of satellite stations and their gathering systems. A great percentage of the total cost of a unit goes into the installation of new flow lines and subsequent salvaging of the old ones. Invariably, the more centralized a battery, consequently requiring longer flow lines, the fewer are the number of satellite stations required, and the smaller the amount of attendant labor required. An economic balance must be run to determine the best installation under the particular circumstances involved.

A further consideration is the possibility of present or future remote automatic control. The satellite stations, with their local automatic control and data printout, could be adapted for control by the central battery. By means of various communications systems, such as microwave, closed circuit telephone, wireless and others, this central battery controls system could be transferred to a remote point such as an area production office. Further refinements could incorporate it into a central control system with other leases. The overall crude oil output of the operator is the only limit to the extent that a supervisory control system such as this could be further centralized with other areas.

This article cannot cover all facets of oilfield production automation, but does present a basis of thought for adaptation to the producer's particular lease. It is intended as a general description and outline of the best procedures developed to date, and as a foundation for future designs. —**The End**

**About the Author**

**Charles E. Golding** received a BS degree in chemical engineering from West Virginia University in 1950, and joined Stanolind Oil and Gas Company shortly thereafter. He gained further oil field experience with Welex Jet Services, Inc., and was employed for 2½ years with Sid Richardson Carbon Company in research and development. He now is engaged in the design and engineering of automatic tank batteries for Odex Engineering Company in Odessa, Texas.

PART 2

# Home markets offer growing outlet for Texas-Louisiana gas reserves

**By 1964, local Texas-Louisiana reserve purchases will absorb half of new reserves found if recent discovery levels are not increased**

**By Roger L. Conkling,** Associate,
H. Zinder & Associates, Inc.
Washington, D. C.

CURRENT GAS RESERVE discovery levels in Texas and Louisiana, which averaged a little less than 15.3 trillion cubic feet in the 1955-59 period, will fall far short of meeting growing demands on the industry in the next five years. By 1964, the annual level of new discoveries, extensions and revisions in these two states will have to increase by about 38 percent to meet the full requirements of local and interstate natural gas markets.[1]

In fact, if recent finding levels are not substantially expanded, the local market alone will absorb half of the new reserves. This situation, well known to the industry itself but misunderstood beyond industry circles, is proved by the annual consumption forecasts presented in WORLD OIL's September issue.

**Translating consumption into reserve requirements.** The market for new reserves has two components, both related to consumption but in different fashions depending upon the purpose for which the reserves are sought.

The first purpose is to maintain the purchaser's reserve position at current levels, that is, to replace the amounts of gas sold during the year through current purchases of new reserves, thus maintaining the reserve "status quo" of the purchaser. Accordingly, the first component of the new reserve market is equivalent to the current level of consumption. An Mcf consumed creates a requirement for an additional Mcf of reserves. The ratio is one-for-one.

The second purpose for which purchases of additional reserves are made is to provide a new reserve supply for expansions and new projects of industrial purchasers, and new loads and load growth of pipe lines and distributors. Here the requirements of the financial world enter the picture.

The investment dollars for new industrial plants or pipeline system additions are not forthcoming unless the expansion is backed up by a long-term reserve supply. The Federal Power Commission is as insistent as the bankers upon a long-term reserve backup for pipeline expansion, and this point has become a large element in certificate cases.

Therefore, growth in consumption creates a much more than equivalent demand for new reserves. This varies somewhere between a "bare bones" 14-year reserve life (or a 14-for-one ratio) to the generally accepted 20-year reserve life standard (a 20-for-one ratio).

**Reserves required for Texas and Louisiana markets.** Table 2 shows the translation of the consumption estimate for Texas and Louisiana, as given in the September issue, into an estimate of new reserve requirements.

## TABLE 2—Requirements for New Texas and Louisiana Reserves

(Discoveries Plus Extensions and Revisions) To Serve Texas and Louisiana Markets—1960-1964

(In MMcf)

| Year | Vented and Wasted | | Field Use | | TOTAL MARKET (EXCLUDING FIELD USE) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Replacement of Current Use | | Provision for Growth | | | |
| | Use Estimate | Reserve Requirement[1] | Market Estimate | Reserve Requirement[1] | Total Market Estimate | Current Market Level | Reserve Requirement[1] | Growth | Reserve Requirement | Total Reserve Requirement | Total Reserve Requirements (b)+(d)+(j) |
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) |
| **Minimum Estimate—Growth Supported by 14-Year Reserve Life** | | | | | | | | | | | |
| 1959 | | | | | 2,650,246 | | | | | | |
| 1960 | 151,150 | 151,150 | 1,061,505 | 1,061,505 | 2,814,495 | 2,650,246 | 2,650,246 | 164,249 | 2,299,486[2] | 4,949,732 | 6,162,387 |
| 1961 | 130,738 | 130,738 | 1,091,341 | 1,091,341 | 2,975,013 | 2,814,495 | 2,814,495 | 160,518 | 2,217,252[2] | 5,061,747 | 6,283,826 |
| 1962 | 116,183 | 116,183 | 1,122,031 | 1,122,031 | 3,139,780 | 2,975,013 | 2,975,013 | 164,767 | 2,306,738[2] | 5,281,751 | 6,519,965 |
| 1963 | 105,700 | 105,700 | 1,148,514 | 1,148,514 | 3,326,283 | 3,139,780 | 3,139,780 | 186,503 | 2,611,042[2] | 5,750,822 | 7,005,036 |
| 1964 | 96,889 | 96,889 | 1,174,568 | 1,174,568 | 3,512,534 | 3,326,283 | 3,326,283 | 186,251 | 2,607,514[2] | 5,933,797 | 7,205,254 |
| **Probable Estimate—Growth Supported by 20-Year Reserve Life** | | | | | | | | | | | |
| 1959 | | | | | 2,650,246 | | | | | | |
| 1960 | 151,150 | 151,150 | 1,061,505 | 1,061,505 | 2,814,495 | 2,650,246 | 2,650,246 | 164,249 | 3,284,980[3] | 5,935,226 | 7,147,881 |
| 1961 | 130,738 | 130,738 | 1,091,341 | 1,091,341 | 2,975,013 | 2,814,495 | 2,814,495 | 160,518 | 3,210,360[3] | 6,024,855 | 7,246,934 |
| 1962 | 116,183 | 116,183 | 1,122,031 | 1,122,031 | 3,139,780 | 2,975,013 | 2,975,013 | 164,767 | 3,295,340[3] | 6,270,353 | 7,508,567 |
| 1963 | 105,700 | 105,700 | 1,148,514 | 1,148,514 | 3,326,283 | 3,139,780 | 3,139,780 | 186,503 | 3,730,060[3] | 6,869,840 | 8,124,054 |
| 1964 | 96,889 | 96,889 | 1,174,568 | 1,174,568 | 3,512,534 | 3,326,283 | 3,326,283 | 186,251 | 3,725,020[3] | 7,051,303 | 8,322,760 |

[1] 1-for-1 basis.
[2] 14-for-1 basis (minimum).
[3] 20-for-1 basis (probable).

## TABLE 3—Requirements for New Texas and Louisiana Reserves

(Discoveries Plus Extensions and Revisions) To Serve United States Market Excluding Texas and Louisiana—1960-1964

(In MMcf)

| Year | Total United States Market | Less Texas and Louisiana Markets | United States Market Less Texas and Louisiana Markets | 61.263% of Column (c) | TOTAL MARKET (EXCLUDING FIELD USE) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Replacement of Current Use | | Provision for Growth | | Total Reserve Requirements |
| | | | | | Current Market Level | Reserve Requirement[1] | Growth | Reserve Requirement | |
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) |
| **Minimum Estimate—Growth Supported by 14-Year Reserve Life** | | | | | | | | | |
| 1958 | 9,156,544 | 2,491,204 | 6,665,340 | 4,083,387 | | | | | |
| 1959 | 9,771,864 | 2,650,246 | 7,121,618 | 4,362,917 | | | | | |
| 1960 | 10,387,491 | 2,814,495 | 7,572,996 | 4,639,445 | 4,362,917 | 4,362,917 | 276,528 | 3,871,392[2] | 8,234,309 |
| 1961 | 11,043,980 | 2,975,013 | 8,068,967 | 4,943,291 | 4,639,445 | 4,639,445 | 303,846 | 4,253,844[2] | 8,893,289 |
| 1962 | 11,686,740 | 3,139,780 | 8,546,960 | 5,236,124 | 4,943,291 | 4,943,291 | 292,833 | 4,099,662[2] | 9,042,953 |
| 1963 | 12,391,450 | 3,326,283 | 9,065,167 | 5,553,593 | 5,236,124 | 5,236,124 | 317,469 | 4,444,566[2] | 9,680,690 |
| 1964 | 13,158,481 | 3,512,534 | 9,645,947 | 5,909,397 | 5,553,593 | 5,553,593 | 355,804 | 4,981,256[2] | 10,534,849 |
| **Probable Estimate—Growth Supported by 20-Year Reserve Life** | | | | | | | | | |
| 1958 | 9,156,544 | 2,491,204 | 6,665,340 | 4,083,387 | | | | | |
| 1959 | 9,771,864 | 2,650,246 | 7,121,618 | 4,362,917 | | | | | |
| 1960 | 10,387,491 | 2,814,495 | 7,572,996 | 4,639,445 | 4,362,917 | 4,362,917 | 276,528 | 5,530,560[3] | 9,893,477 |
| 1961 | 11,043,980 | 2,975,013 | 8,068,967 | 4,943,291 | 4,639,445 | 4,639,445 | 303,846 | 6,076,920[3] | 10,716,365 |
| 1962 | 11,686,740 | 3,139,780 | 8,546,960 | 5,236,124 | 4,943,291 | 4,943,291 | 292,833 | 5,856,660[3] | 10,799,951 |
| 1963 | 12,391,450 | 3,326,283 | 9,065,157 | 5,553,593 | 5,236,124 | 5,236,124 | 317,469 | 6,349,380[3] | 11,585,504 |
| 1964 | 13,158,481 | 3,512,534 | 9,645,947 | 5,909,397 | 5,553,593 | 5,553,593 | 355,804 | 7,116,080[3] | 12,669,673 |

[1] 1-for-1 basis.
[2] 14-for-1 basis (minimum).
[3] 20-for-1 basis (probable).

The top section of the table calculates growth requirements on the minimum 14-year reserve life basis. The bottom part of the table calculates these growth requirements on the more realistic 20-year standard.

Since gas vented and wasted represents a depletion of reserves, it is included in the estimate on a one-for-one basis. Field use is also included on a one-for-one basis, although reserves are established and held for this purpose, to compensate for the difference between the Bureau of Mines treatment of field use upon which the estimate is based and the AGA-API computation of reserves (which separates gas and natural gas liquids reserves).

As shown on Table 2, in 1964, annual reserve purchases for the Texas and Louisiana markets, plus field use and an allowance for gas vented and wasted, will range somewhere between a minimum of 7.2 trillion cubic feet and the more likely total of 8.3 trillion cubic feet.

**Local market requirements compared with current finding level.** These figures are more meaningful if compared with a "yardstick" measure of reserves becoming available for sale. The new reserves (new discover-

ies plus extensions and revisions) found in Texas and Louisiana in the 5-year period, 1955-59, averaged 15,260,855,000,000 cubic feet. Using this figure as a yardstick, the proportion of new Texas and Louisiana reserves which will be required for local markets is as follows:

**Reserve Requirements of the Texas and Louisiana Markets As Percent of Yardstick Level of Reserve Additions**

| Year | Minimum Requirements | Probable Requirements |
|---|---|---|
| 1960 | 40.38% | 46.84% |
| 1961 | 41.18 | 47.49 |
| 1962 | 42.72 | 49.20 |
| 1962 | 45.90 | 53.23 |
| 1964 | 47.21 | 54.54 |

Assuming actual reserve purchases for local markets will fall somewhere between minimum and probable requirements, the reserve purchases for local consumption will absorb at least half of the new reserves found if the yardstick level is not exceeded.

**Interstate market demands for Texas and Louisiana reserves.** Combined local plus interstate requirements for new Texas and Louisiana reserves—and the relationship of this combined total to the yardstick finding level—are of major significance to all segments of the natural gas industry since these states are looked upon for such a major share of the new U.S. gas supply. This requires a computation of that portion of U.S. reserve requirements (other than requirements of the local Texas and Louisiana markets themselves as tabulated on Table 2) which might conservatively be expected to be supplied from new Texas and Louisiana reserves, as shown in Table 3.

This table is derived from the American Gas Association forecast of United States consumption. To be on the low side it is assumed that Texas and Louisiana will be responsible for providing only about 61 percent of the reserve needs of other states, although a higher figure is undoubtedly warranted.

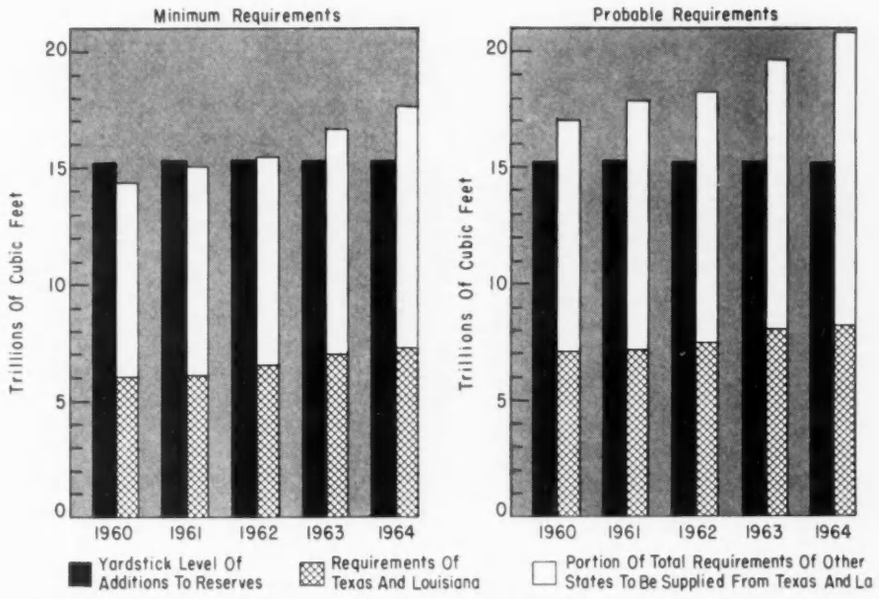



**FIGURE 3—Requirements for new Texas and Louisiana reserves (discoveries plus extensions and revisions) 1960-1964.**

Table 3 shows that by 1964 requirements for new Texas and Louisiana reserves resulting from consumption demands in other states will range from a minimum level of 10.5 trillion cubic feet to a probable level of a little less than 12.7 trillion cubic feet, bringing the total requirements for new reserves in these states to between 17.7 trillion cubic feet and 21 trillion cubic feet.

**Total requirements for Texas and Louisiana reserves.** A comparison of total requirements for new reserves in Texas and Louisiana with the 1955-59 yardstick level of reserve additions is given in Table 4 and Figure 3.

By 1964 the yardstick level of new reserves will fail by 2.5 trillion cubic feet, or 16 percent, of meeting the minimum reserve requirement. It will be a staggering 5.7 trillion cubic feet, or almost 38 percent, below the probable reserve requirement. (See Figure 4). Cumulative deficiencies over the 1960-64 period could reach almost 18 trillion cubic feet by the end-year. (See Figure 4.)

**An alternative approach.** It has been suggested that the extremely high 1959 level of reserve additions in Texas and Louisiana might represent a permanently higher plateau of finding in these states.

While it is believed that a single year basis is unacceptable for evalua-

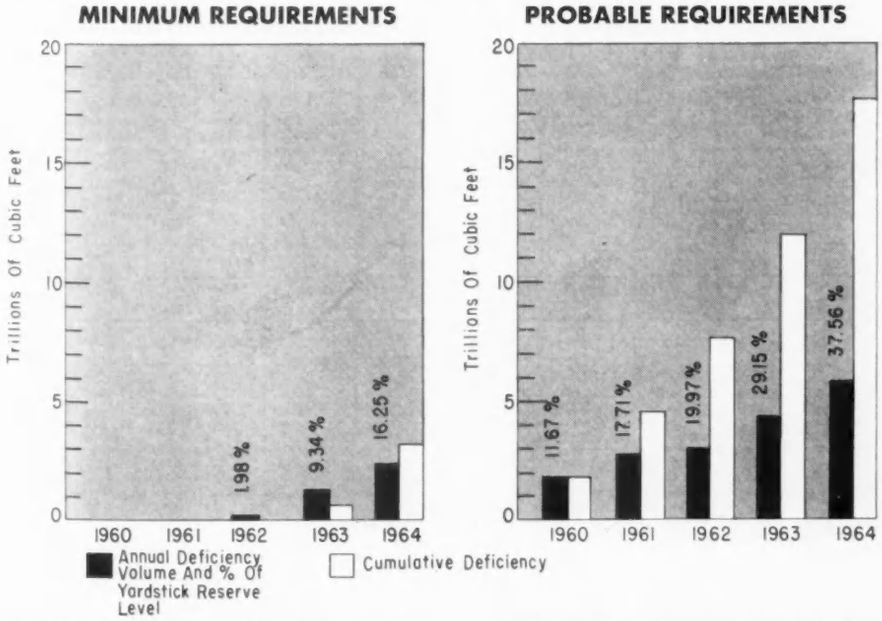



**FIGURE 4—Texas and Louisiana new reserve deficiency based upon gross additions to reserves at yardstick level (15,260,855,000,000 cubic feet) and Table 4 data—1960-1964.**

tion or yardstick purposes, this concept is easily tested. On such a single-year basis, Texas and Louisiana become responsible for 90 percent of the total reserve additions in the United States (which is a jump from the 71 percent or lower percentage of earlier years), instead of the 61 percent responsibility assumed in the preceding computations.

If 90 percent of the new additions to United States reserves are to be found in these two states and only 10 percent elsewhere, for all practical purposes the role of Texas and Louisiana changes from that of an important contributor to almost the sole source of new U.S. gas supply.

Under this assumption, the measure of the adequacy of reserve finding levels in these states is a simple direct comparison between total U.S. requirements and total U.S. reserve additions, with 1959 additions used as a yardstick. This comparison is shown on Table 5.

Except for the addition of a total United States estimate for vented and wasted and for field use and the substitution of gross additions to reserves in the nation in 1959 as the yardstick, the data used in this table are the same as in the preceding tables. Even greater deficiencies are indicated under this approach than the former.

**Significance to the industry.** The foregoing studies point to the absolute necessity for accelerating exploration and development to bring reserve additions to a level substantially above that of the preceding five years. This can only be done by providing adequate producer incentives, which are, of course, a function of producer prices.

The extent of the inflow of capital into any industry, whether from internally generated funds or from outside financial sources, varies with the expected earnings. This fundamental fact is recognized by all economists. The producing industry is no exception.

For example, Harvard economist John Kenneth Galbraith in his widely read The Affluent Society, states "Investment in material capital is distributed to the various claimant industries by the market. If earnings are high (at the margin) in the oil industry and low in the textile business, it is to the oil industry that capital will flow. This allocation by the market works, it would appear, with tolerable efficiency."

**TABLE 4—Total Requirements for Texas and Louisiana Reserves (Discoveries Plus Extensions and Revisions) To Serve United States Market—1960-1964**
(In MMcf)

| Year | "Reserve Yardstick"[1] Gross Additions to Reserves | Texas and Louisiana Markets | United States Market Less Texas and Louisiana Markets | Total Requirements | Surplus (Deficiency) Based Upon Gross Additions to Reserves at Yardstick Level[1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Annual | | Cumulative |
| | | | | | MMcf | Percent | |
| | (a) | (b) | (c) | (b) + (c) (d) | (d) — (a) (e) | (f) | (g) |
| **Minimum Estimate** | | | | | | | |
| 1960 | 15,260,855 | 6,162,387 | 8,234,309 | 14,396,696 | 864,159 | 5.66 | 864,159 |
| 1961 | 15,260,855 | 6,283,826 | 8,893,289 | 15,177,115 | 83,740 | 0.55 | 947,899 |
| 1962 | 15,260,855 | 6,519,965 | 9,042,953 | 15,562,918 | (302,063) | (1.98) | 645,836 |
| 1963 | 15,260,855 | 7,005,036 | 9,680,690 | 16,685,726 | (1,424,871) | (9.34) | (779,035) |
| 1964 | 15,260,855 | 7,205,254 | 10,534,849 | 17,740,103 | (2,479,248) | (16.25) | (3,258,283) |
| **Probable Estimate** | | | | | | | |
| 1960 | 15,260,855 | 7,147,881 | 9,893,477 | 17,041,358 | (1,780,503) | (11.67) | (1,780,503) |
| 1961 | 15,260,855 | 7,246,934 | 10,716,365 | 17,963,299 | (2,702,444) | (17.71) | (4,482,947) |
| 1962 | 15,260,855 | 7,508,567 | 10,799,951 | 18,308,518 | (3,047,663) | (19.97) | (7,530,610) |
| 1963 | 15,260,855 | 8,124,054 | 11,585,504 | 19,709,558 | (4,448,703) | (29.15) | (11,979,313) |
| 1964 | 15,260,855 | 8,322,760 | 12,669,673 | 20,992,433 | (5,731,578) | (37.56) | (17,710,891) |

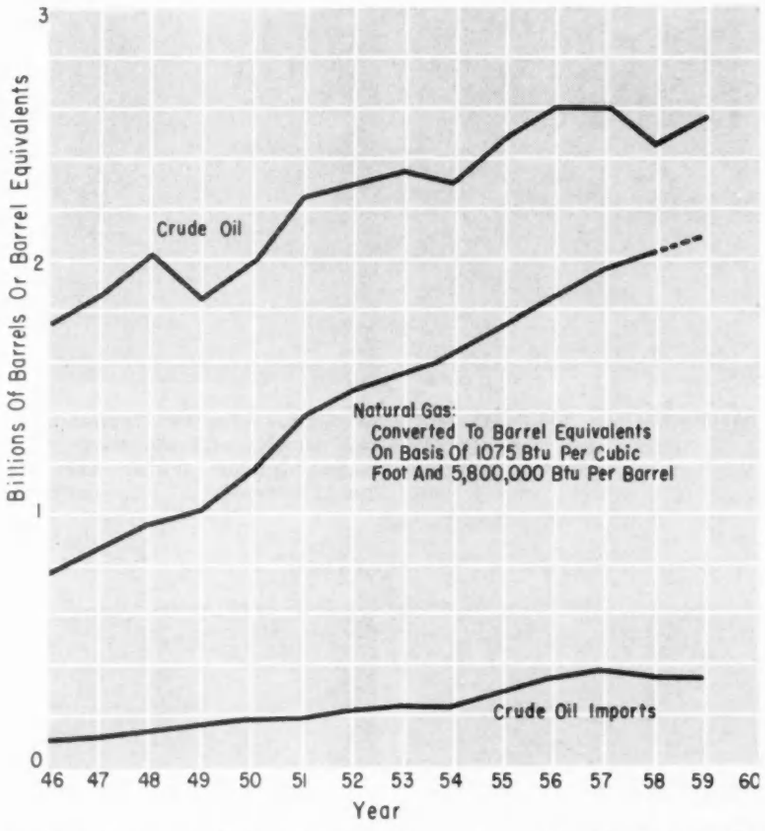
[1] Average gross additions to reserves, 1955–1959, Texas and Louisiana.

**TABLE 5—Requirements for New U.S. Natural Gas Reserves (1960-1964) Discoveries Plus Extensions and Revisions**
(In MMcf)

TOTAL MARKET (EXCLUDING FIELD USE)

| Year | Vented and Wasted | | Field Use | | Total Market Estimate | Replacement of Current Use | | Provision for Growth | | Total Reserve Requirement | Total Reserve Requirement | "Reserve Yardstick" 1959 Gross Additions To Reserves[2] | Surplus (Deficiency) Based Upon Gross Additions to Reserves at "Yardstick" Level | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Use Estimate | Reserve Requirement | Market Estimate | Reserve Requirement[1] | | Current Market Level | Reserve Requirement[1] | Growth | Reserve Requirement | | | | Annual | | Cumulative |
| | | | | | | | | | | | | | MMcf | Percent | |
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (g) + (i) (j) | (b) + (d) + (j) (k) | (l) | (l) — (k) (m) | (n) | (o) |
| **Minimum Estimate** | | | | | | | | | | | | | | | |
| 1959 | 610,500 | 610,500 | 1,607,500 | 1,607,500 | 9,771,864 | | | | | | | | | | |
| 1960 | 592,500 | 592,500 | 1,612,500 | 1,612,500 | 10,387,491 | 9,771,864 | 9,771,864 | 615,627 | 8,618,778[3] | 18,390,642 | 20,595,642 | 20,733,858 | 138,216 | 0.67% | 138,216 |
| 1961 | 572,500 | 572,500 | 1,617,500 | 1,617,500 | 11,043,980 | 10,387,491 | 10,387,491 | 656,489 | 9,190,846[3] | 19,578,337 | 21,768,337 | 20,733,858 | (1,034,479) | (4.99) | (896,263) |
| 1962 | 550,500 | 550,500 | 1,620,500 | 1,620,500 | 11,686,740 | 11,043,980 | 11,043,980 | 642,760 | 8,998,640[3] | 20,042,620 | 22,213,620 | 20,733,858 | (1,479,762) | (7.14) | (2,376,025) |
| 1963 | 532,500 | 532,500 | 1,625,000 | 1,625,000 | 12,391,450 | 11,686,740 | 11,686,740 | 704,710 | 9,865,940[3] | 21,552,680 | 23,710,180 | 20,733,858 | (2,976,322) | (14.35) | (5,352,347) |
| 1964 | 510,500 | 510,500 | 1,630,000 | 1,630,000 | 13,158,481 | 12,391,450 | 12,391,450 | 767,031 | 10,738,434[3] | 23,129,884 | 25,270,384 | 20,733,858 | (4,536,526) | (21.88) | (9,888,873 |
| **Probable Estimate** | | | | | | | | | | | | | | | |
| 1959 | 610,500 | 610,500 | 1,607,500 | 1,607,500 | 9,771,864 | | | | | | | | | | |
| 1960 | 592,500 | 592,500 | 1,612,500 | 1,612,500 | 10,387,491 | 9,771,864 | 9,771,864 | 615,627 | 12,312,540[4] | 22,084,404 | 24,289,404 | 20,733,858 | (3,555,546) | (17.15) | (3,555,546) |
| 1961 | 572,500 | 572,500 | 1,617,500 | 1,617,500 | 11,043,980 | 10,387,491 | 10,387,491 | 656,489 | 13,129,780[4] | 23,517,271 | 25,707,271 | 20,733,858 | (4,973,413) | (23.99) | (8,528,959) |
| 1962 | 550,500 | 550,500 | 1,620,500 | 1,620,500 | 11,686,740 | 11,043,980 | 11,043,980 | 642,760 | 12,855,200[4] | 23,899,180 | 26,070,180 | 20,733,858 | (5,336,322) | (25.74) | (13,865,281) |
| 1963 | 532,500 | 532,500 | 1,625,000 | 1,625,000 | 12,391,450 | 11,686,740 | 11,686,740 | 704,710 | 14,094,200[4] | 25,780,940 | 27,938,440 | 20,733,858 | (7,204,582) | (34.75) | (21,069,863) |
| 1964 | 510,500 | 510,500 | 1,630,000 | 1,630,000 | 13,158,481 | 12,391,450 | 12,391,450 | 767,031 | 15,340,620[4] | 27,732,070 | 29,872,570 | 20,733,858 | (9,138,712) | (44.08) | (30,208,575) |

[1] 1-for-1 basis.
[2] Total United States, per A.P.I. and A.G.A.
[3] 14-for-1 basis (minimum).
[4] 20-for-1 basis (probable).




Marketed Production of Natural Gas and Production of Crude Oil United States.

## How natural gas and imports have affected U.S. crude oil production

In September, WORLD OIL presented a comparison for Texas and Louisiana of the marketed production of natural gas and the production of crude oil. The above chart presents this same information for the United States as a whole.

Oil production is shown in barrels and gas production in barrel equivalents. Crude oil imports in barrels also are shown.

Note that marketed production of natural gas increased 183 percent from 1946 to 1959, while crude oil production increased only 48 percent. Over the same period, crude oil imports increased 305 percent.

Since gas and oil compete with each other in the nation's fuel market, the dramatic increase in the use of natural gas, accentuated by the increase in crude oil imports, has had a materially dampening effect upon requirements for domestic crude oil production.

Obviously, the stimulation of the increased capital into the oil industry which is needed to accelerate producer efforts, must come from prospective earnings which are sufficiently attractive to compete successfully in the financial market. The requirements of the natural gas market will be met only if producers can meet the competition for funds in the financial market.

Insofar as the interstate market for new reserve supplies is concerned, it will face increasingly stringent competition from local markets. These local markets shortly will absorb one-half or more of the total new reserves at the yardstick level and can no longer be considered incidental in the over-all natural gas market structure.

[1] The studies reported in this article, adjusted to reflect 1959 reserve addition levels which were not then available, formed part of the testimony submitted by the CATC producer group, Continental, Atlantic Refining, Tidewater, and Cities Service, at the PFC rehearing ordered by the U.S Supreme Court of the certificate case involving the sale of offshore Cameron area gas to Tennessee Gas Transmission.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# Downhole camera helps solve production problems

**Photographs obtained in the borehole aid fishing operations and indicate success of stimulation treatments and cement jobs**

**By Lloyd C. Fons**
Birdwell Division of Seismograph Service Corp., Tulsa

A SMALL DIAMETER downhole camera is being used to solve many drilling and production problems by photographing actual conditions in the wellbore. At present, the tool is applicable only in dry or gas filled wells. Usable photographs have not been obtained in liquid filled wells; however, pictures can often be taken in such wells by bailing the liquid level to a point below the zone of interest. A second method is to run the tool through a lubricator and displace the liquid below the point of interest with gas.

As indicated in the accompanying photos, the technique can be most helpful in determining the attitude and orientation of fish, orientation and type of hydraulic fracture, success of cement jobs, hole configuration, type of plugging agent on the sand face, etc.

The camera uses 16 millimeter rolled film and is capable of taking 1,000 pictures with a single trip into the well. The camera lens is mounted at the base of the tool and looks straight down the hole with a focal range downward of six inches through three feet. A doughnut shaped light source surrounds the lens and supplies the desired light upon a signal from the surface. After each exposure the film automatically rolls to the next ready position.

The entire tool is 4½ inches in diameter and four feet long. Normal operation has been observed at temperatures up to 200°F and pressures of 4,000 psi.

Normally, borehole picture studies yield depth controlled information as to rock types, bed boundaries, faulting, fractures, hole size and hole shape. A compass may be added to the running string below the camera. When photographed with each picture (in uncased sections), the compass provides directional orientation of observed formation and borehole conditions.

Since the camera will always rest on the low side of the borehole wall, compass oriented pictures make it possible to determine both direction of hole deviation from the vertical and the directional orientation of natural or induced fracture systems intersecting the well bore. Thus, fracture system orientation and borehole deviation data from a single well is of value in understanding regional tectonics, forecasting structural trends, and staking new locations.

Figure 1 is a photograph taken at 3,031 feet. The photo indicates sand at that depth, an in-gage round hole deviating from the vertical to the northwest and a hydraulically induced vertical fracture system extending northeast-southwest.

In some areas, all camera pictures of hydraulically fractured wells have indicated northeast-southwest oriented

**FIGURE 1—Borehole camera with compass attachment below shows sand formation at 3,031 feet. Note vertical hydraulic fracture.**

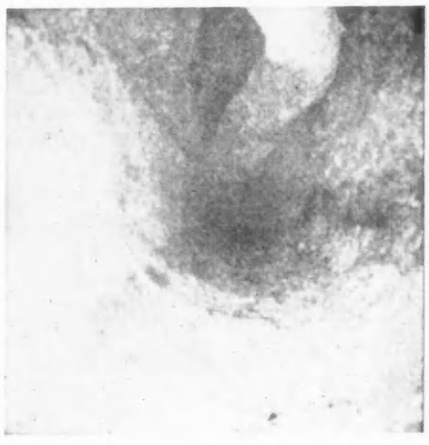

**FIGURE 5—This fish was lost in open hole at 3,650 feet. Photo enabled operator to determine exact position of the fish in the hole, and fish accordingly.**

**FIGURE 9—Six-inch casing has been misaligned below 15-inch pipe. Because of the offset, hole was drilled outside liner.**

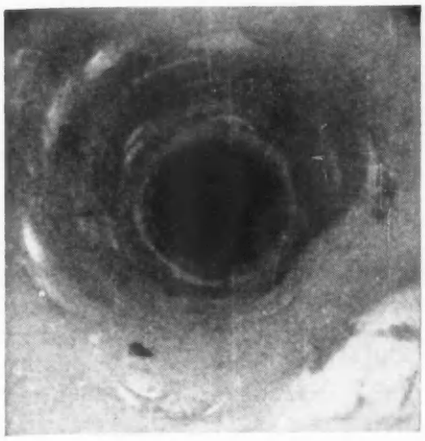

FIGURE 2—This collapsed casing was caused by bullet perforating in low porosity formation. The damaged section of pipe is indicated in lower right hand portion of photo.

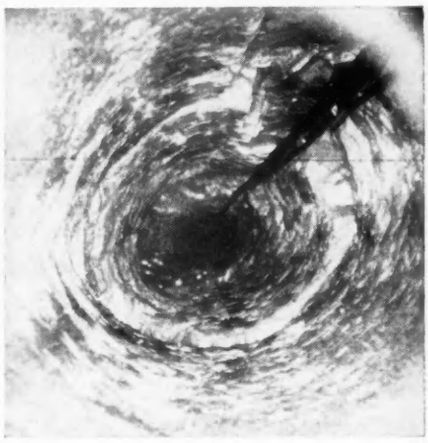

FIGURE 3—Cable tool drilled non-circular hole has 10-inch deep groove worn for 500 feet on one side of the hole. Groove was caused by action of the drill line.

FIGURE 4—Cement sheath has effectively blocked the formation face in this hole. Pipe was set on top of pay and cemented. After cleanout, the formation was blocked as shown.

FIGURE 6—This tubing was lost in the hole at 3,648 feet. Flared top and orientation away from the low side of hole increased recovery problem. Note the enlarged, non-circular hole.

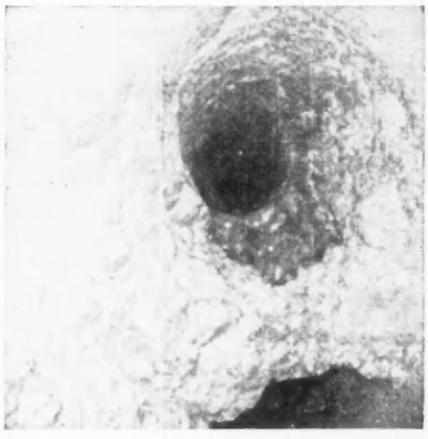

FIGURE 7—Operator unintentionally sidetracked hole at 851 feet. Fish was lost in original hole but fishing tool string was so designed that it would enter only the sidetracked hole. Picture enabled operator to design a guide to get fishing tools in to the correct wellbore.

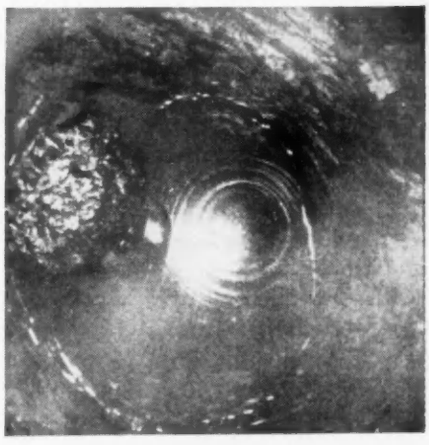

FIGURE 8—Photo of lost string of cable tools indicates fish has flared top.

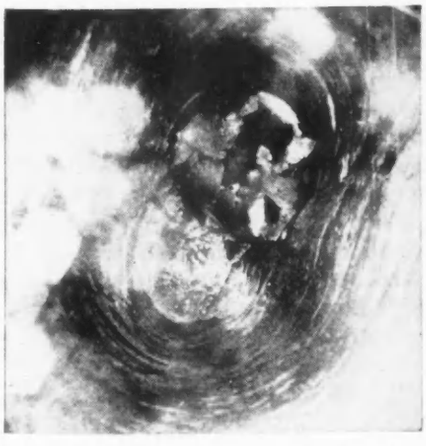

FIGURE 10—The top of this liner has been flanged shut and tools were deflected to the side. Thus, hole was drilled outside the casing.

FIGURE 11—This photo shows a casing failure at 4,014 feet in an eastern gas well. Note the parted section of pipe.

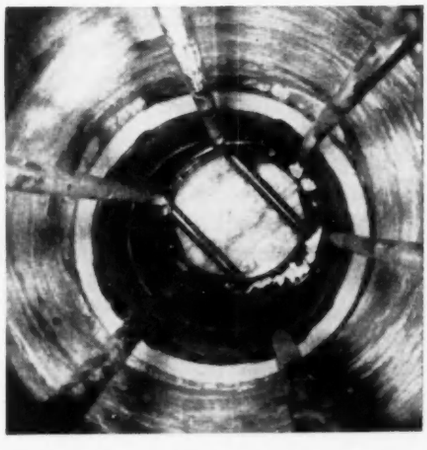

FIGURE 12—The camera is looking uphole at the bottom of the casing shoe in this shot. Note the discontinuous cement job around the casing shoe.

vertical fractures. These vertical fractures commonly extend through and below the bottom of the drilled hole. In certain areas of open hole completions, camera studies have supplemented and confirmed radioactive tracer surveys which would indicate that even at moderately shallow depths only a small amount of formation surface area can be exposed to fracturing pressure without the creation of vertical fractures. Radioactive frac tracer surveys in these same areas, where fracture treatment has been performed through perforations, has indicated that vertical fracturing is directly related to the amount of section perforated.

In waterflood areas, determination of fracture orientation is worthwhile. The presence or creation of vertical fractures pointed in the direction of offset producing wells may greatly reduce sweep efficiency. Creation of vertical fractures connecting injection wells would in most cases be ideal. Thus, it appears that the regional geology of an area should be rather closely studied in the tailoring of flood patterns.

In situ picture studies of casing perforations have indicated that reduced shot density may be one means of preventing communication between perforations. When communication does occur, selective treatment of productive zones and furture selective production of formation fluids may be imposible. Figure 2 shows damaged pipe which was perforated in low porosity rock.

In many cable tool drilling areas, holes vary from round shape to oval, almond shape or even square. Figures 3 and 6 show non-circular holes.

There are several possible explanations for non-circular holes. One would be that the holes are originally inclined from the vertical and subsequently wear on the low side. Another is that there are dominant directional planes of weakness which, during the drilling process, make for preferential chipping in the direction of hole elongation. The drilling of odd shaped holes would account for considerable difficulty in calculating volumes and setting open hole packers.

Figure 3 also shows a deep groove worn into the borehole wall by the action of the drilling line in the cable tool drilling of an 840-foot well. Caliper surveys indicated the groove to be 10 inches deep. Also, the groove extended for almost 500 feet, thus providing another difficult area for effective packer setting or cement jobs.

Figure 4 indicates varying degrees of formation face damage caused by poor cementing techniques. In wells where the pay is drilled prior to the setting of casing on top and cementing it is quite common for a part of or all the mud or water below the casing shoe to be displaced out into the formation by fluid cement. When this happens a cement filter cake forms on the wall of the hole opposite all permeable zones exposed to cement and the producing formation is completely sealed off down to this depth. Later when drilling out the hardened cement the bit may merely drill a hole through its center leaving a continuous or almost continuous sheath of cement blocking the formation face.

Pictures and many radioactive tracer surveys indicate that it is not uncommon for entire producing zones to be unproductive because of cement contamination. From information gathered to date it is believed that cement sheaths as mentioned above greatly reduce production or injection in many wells. The use of temporary plug backs or packer type casing shoes appears to be a worthwhile preventive measure when setting on top subsequent to drilling the pay. Borehole camera pictures have also shown rotary mud cake on borehole walls which is equally as good (or bad) as cement at restricting the flow of wanted or injected fluids.

Camera pictures have been invaluable in conforming the results of radioactive tracer permeability profile surveys which are run under dynamic in situ conditions and seldom match core analysis permability profiles.

**Fishing.** Borehole pictures have been used in fishing operations for selection of proper fishing tools. Many well completions hinge on the recovery from the well of lost tools or equipment. Large sums of money and many weeks of time may be spent on fishing operations for lack of information as to depth and shape of the fish or its orientation in the hole.

Figure 5 shows a picture taken during a fishing operation in open hole and indicates a section of pipe at 3,650 feet. Since the pipe is on one side of the hole, fishing operations are made more difficult.

Figure 6 shows the top of a tubing string lost in a well at 3,648 feet. The fish's flared top and orientation away from the low side of the hole would have made for difficult recovery. In addition to supplying this necessary information the picture indicates an enlarged non-round hole and the exact depth to the top of the fish.

Figure 7 was taken during a fishing operation at 851 feet. As indicated, the hole divides into two holes at that depth. The fish was lost in one hole and it was found that the operator was fishing in the other. The camera job allowed the operator to devise a guide and properly position the fishing tools for a successful fishing job.

Figure 8 was taken at 3,225 feet during a fishing operation for a lost string of cable tools. It indicates an enlarged hole, flared fishing surface and a difficult fishing job ahead.

Figure 9 taken during a workover job, shows 6-inch casing misaligned below 15-inch pipe. This resulted in failure to lower tools inside the 6-inch casing and hole was drilled outside the 6-inch pipe.

Figure 10 was taken during a workover job, and shows the top of a liner which has been flanged shut by action of the drilling tools. This resulted in failure to enter the liner, and hole was drilled along the side of the pipe.

Pipe condition also has been determined by borehole pictures. Figure 11 shows a pipe failure at 4,014 feet in an eastern gas well. Figure 12 indicates the condition of a casing shoe and cement job. The camera has been pointed in an upward direction and pictures taken. In a number of similar cases the cement around the casing shoe has been observed to be unsymmetrical and discontinuous. Figure 12 shows such a condition.

Much additional study needs to be done on well completion and stimulation techniques, and results obtained down hole. Well bore pictures are supplying much information not previously obtainable and are bringing to light many significant but little realized conditions existing in well bores and the surrounding formations.


#### ACKNOWLEDGMENT

The author wishes to express his appreciation to Ronald K. Ault, Birdwell's eastern area manager, for his cooperation in obtaining pictures for this article and for his constructive interest in borehole camera work.


#### BIBLIOGRAPHY


J. C. Dempsey and J. R. Hickey, "Use of a Borehole Camera for Visual Inspection of Hydraulically-Induced Fractures" *Producers Monthly* (April, 1958).

# Dual completion workover program increases production

**Cities Service has recovered 359,720 barrels of additional oil from one field by extending perforations, fracturing and converting single string duals to twin string installations with retrievable gas lift equipment**

**By Earl H. Furrey, Jr.**
District Engineer, Cities Service Oil Co., Hobbs, N. M.

CITIES SERVICE OIL COMPANY'S workover program of dually completed Devonian and Clearfork wells in the Dollarhide field of West Texas has been very successful economically and indicates that a planned program can be followed and results anticipated. As of Jan. 1, 1960, approximately 359,720 barrels of additional oil had been recovered as a result of these workovers. Changes made in methods and selection of equipment initially used have provided more efficient operations and better results. The two chief changes involved switching from acid treatments to sand-oil fracturing and replacing a single tubing string with two strings of tubing with retrievable gas lift equipment.

The Dollarhide field is located in the southwest corner of Andrews County, Texas, and covers an aerial extent of approximately 6,400 surface acres. This multi-pay field produces from the Clearfork, Devonian, Silurian and Ellenburger formations. This article will discuss workovers in the Devonian and Clearfork formations. Cities Service has drilled 31 wells in the field with 22 dual completions in the Clearfork and Devonian, seven single completions in the Devonian, one single completion in the Clearfork and one dry hole.

**Geology.** The Devonian formation produces from two porous intervals at an average depth of 8,000 feet. The upper interval is a dolomitic limestone with intergranular and some fracture type porosity. The lower interval is a chert section with secondary type porosity and produces the major portion of the oil. The zones are approximately 28 feet and 48 feet thick, respectively, and are separated by a dense dolomitic limestone which varies in thickness from 70 to 150 feet.

The Clearfork formation produces from three intervals: the Upper Clearfork, the Tubbs and the Lower Clearfork. All of these producing intervals are fine crystalline dolomite with a slight vugular and intergranular porosity. The Tubbs interval contains approximately 10 percent sand in the top 60 feet. The top of Clearfork production is at approximately 6,300 feet.

**Completion methods.** The majority of the Devonian wells have been completed by drilling through both of the Devonian producing intervals, setting pipe into the top of the chert interval and producing from this section.

Seven wells also have had the upper interval perforated and produce from both intervals. There are two wells where pipe has been set through the lower interval and then perforated in the lower interval only. All perforating has been done with four jet shots per foot.

On all Clearfork producers, pipe was set through the producing intervals and then perforated over 75 feet to 100 feet of the section with four jets per foot.

On initial completion both the Clearfork and the Devonian were treated with 15 percent HCl acid. The Clearfork was treated with 7,500 gallons and the Devonian with 5,000 gallons.

For all dual completions, initial practice was to install a permanent type packer approximately 30 feet above the top of the Devonian. A string of 2½-inch EUE tubing then was run and set into the packer with a side door choke assembly one joint above the packer. A separation tool was run and the Clearfork was swabbed-in. A straight tool then was run and the Devonian was swabbed-in and left flowing up the tubing with the Clearfork producing up the casing.

In some cases, the Clearfork would not flow in the casing and a crossover packer was run and set above the Clearfork perforations since the formation would flow through tubing. Thus, the Devonian was crossed-over from tubing to casing and the Clearfork from casing to tubing.

**Production history.** Devonian wells potentialed for an average of 495 bopd with an initial average GOR of 600:1 and an average BHP of 3,325 psi. All wells potentialed and received top allowable for the field which is 100 barrels per calendar day.

Peak oil production from the Devonian was reached in April 1953, when an average of 2,569 bpd were produced from 28 wells. Since April 1953, production declined until 1958, when it leveled at 850 bopd. From 1949 to 1959, average BHP dropped from 3,325 psi to 1,325 psi, and the average gas-oil ratio rose from 600:1 to 7,400:1.

Wells producing from the Clearfork formation had an average initial potential of 687 bpd with an average GOR of 750:1 and an average BHP of 3,000 psi. On initial completion, all wells received top allowable of 91 barrels per calendar day.

Peak oil production from the Clearfork was reached in April 1953, when production averaged 1,910 bpd from 23 wells. Production followed a steady decline until it reached a low of 755

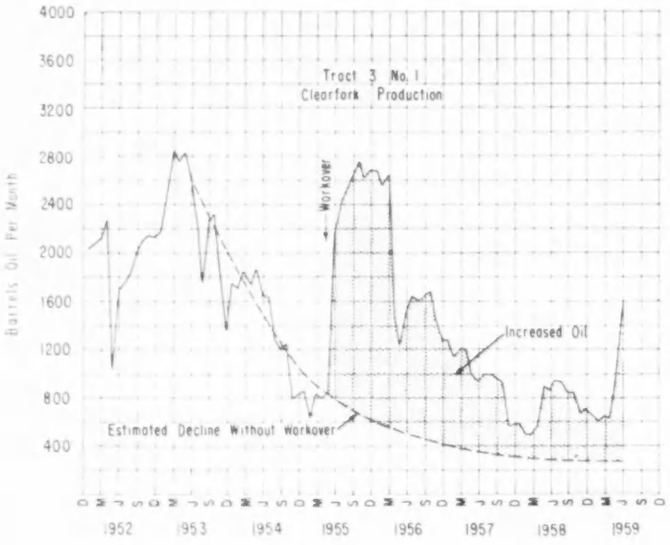


FIGURE 1

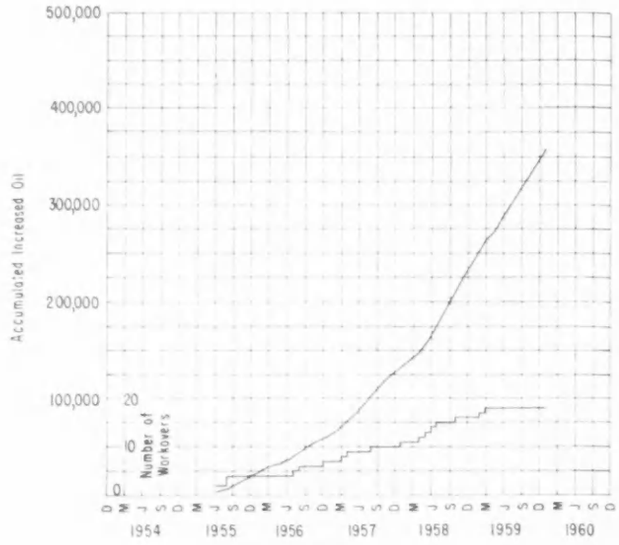


FIGURE 2

**This production history (left) of the first well to be worked over under the Cities Service program shows results obtained by opening additional perforations in the Clearfork and acidizing. Prior to workover, the well tested 33 bopd with GOR of 5696/1. After workover, the well potentialed 322 bopd with GOR of 1721/1. Figure 2 is a comparison of increased oil obtained through the workover program with the number of jobs performed. Approximately 359,720 barrels of additional oil had been recovered as of Jan. 1, 1960.**

bpd in March 1958. Production then gradually climbed to an average of 950 bpd. During the period 1949-1959, bottom hole pressure declined from 3,000 psi to 700 psi, and the GOR rose from 750:1 to 6,200:1.

**Workover program.** During the first part of 1955, a study was made of the Cities Service portion of the field and a workover program was initiated. This study showed that there was a number of pay intervals in the Clearfork which had not been opened for production.

The first workover was performed in May 1955 on Tract 3 Well 1, and consisted of perforating additional zones in the Clearfork and acidizing. Prior to workover, this well was producing 33 bpd with a GOR of 5,696. in June 1955, the well repotentialed for 382 bpd with a gas-oil ratio of 1,721 which resulted in an allowable increase from 31 bpd to 91 bpd.

Figure 1 is a production curve of Tract 3 Well 1. It can be seen that production has remained over the estimated decline curve without additional workover since the initial job. This increased oil represents a total of 45,168 barrels since May 1955, and the payout on this workover is approximately 375 percent. Figure 2 shows a comparison of increased oil with the total number of workovers in the field.

As of July 1, 1959, a total of 18 workovers have been performed on Cities Service wells in the Dollarhide field. Work on the Clearfork formation consisted of perforating additional zones and acidizing and/or fracturing both the new and old producing intervals. Work on the Devonian formation has been restricted to acidizing since a permanent type packer is set above the Devonian in all dual wells.

**Workover procedure.** A contract rig equipped with a double jackknife derrick is used on all workover jobs. The rig is complete with one steel pit (capacity 180 barrels), blow-out preventers, crews and all other equipment with the exception of drill pipe.

After the workover rig has been moved in, the well is killed using lease crude. Tubing and casing then are treated with hot oil to remove paraffin. Previous experience indicated that if a well was not hot oiled prior to pulling pipe, difficulty could be expected when running and retrieving packers due to accumulation of paraffin in the casing.

After hot oiling the well, the 2½-inch tubing is pulled and a retrievable bridge plug is run and set above the permanent type packer. A gamma ray correlation and collar log is run since many of the original logs were of the open hole type. A wire line junk basket is set on top of the retrievable bridge plug and additional zones in the Clearfork are perforated with four jet shots per foot.

The junk basket then is retrieved and the well is fractured down the casing. The normal job will consist of 45,000 gallons of lease crude with one-tenth pound of fluid loss material, 45,000 pounds of sand and 10,000 gallons of acid. This is broken down into three stages and is performed as follows:

1. Breakdown formation with lease crude with fluid loss material only.
2. Fracture with 15,000 pounds sand and 15,000 gallons lease crude with one-tenth pound fluid loss material per gallon.
3. One thouand pounds moth balls with lease crude to block off initial fracture job.
4. Five thousand gallons 15 percent HCl acid to break down new zone.
5. Fifteen thousand pounds sand and 15,000 gallons lease crude.
6. One thousand pounds moth balls with lease crude to block off second stage.
7. Five thousand gallons 15 percent HCl acid to break down additional zones.
8. Fifteen thousand pounds sand and 15,000 gallons lease crude.
9. Lease crude to flush casing.

Equipment used in treating the wells consists of five trucks with a

total brake horsepower of 3,250 and hydraulic horsepower of 2,500. These five units are capable of pumping 50 bpm at 2,000 psi. One blender with a sand-oil blending capacity of 60 bpm is used.

All sand-oil fracturing has been done down seven inch casing at an average injection rate of 33 bpm at 2,700 psi. In some jobs, injection rates of 45 bpm have been obtained. All oil used in the treatments has one-tenth pound of fluid loss material per gallon added and this has resulted in an average fluid loss between 10 and 15 cc's. The addition of the fluid loss material is believed to have prevented screen outs that were encountered prior to using this material.

After the fracture job, the well is left shut-in for a period of four to six hours. If pressure still is on the well after this period, it is opened up and allowed to flow back. On most workovers the well will flow back 150 to 200 barrels before dying, and in some cases it has been necessary to pump into the well to kill it.

When the well is dead, the 2½-inch tubing is run in to clean out any sand and to retrieve the bridge plug. It is normal to find 12 to 15 feet of sand on top of the bridge plug. It is believed that this sand accumulates in the well bore during the time the well is allowed to back flow.

After retrieving the bridge plug, tubing is run immediately. The single string of 2½-inch EUE tubing is replaced with two strings of 2-inch tubing. The long string, or Devonian string, is run with a stinger which is received by the permanent packer, and a dual packer which is set just above the Clearfork perforations.

The Devonian tubing string above the dual packer is equipped with turned down collars and side pocket gas lift valve mandrels with dummy valves. After the long string is landed, the Devonian formation is acidized and tested before running the short string. This is done to make sure that there is no leakage in either the tubing or the lower packer. The Devonian is not killed before running the Clearfork string, but is shut-in by the use of a plug set in the tubing string. The Clearfork string, also equipped with gas-lift equipment, then is run and the well is returned to production by gas lift.

During 1958, work was begun in preparation for a waterflood of the Devonian formation. With the idea of lifting 300 to 350 bfpd from an average depth of 8,000 feet, the installation of artificial lift equipment at the time of workover was studied and the use of dual gas-lift equipment was decided upon. This dual gas-lift equipment utilizes a common source of gas and all equipment is wire line retrievable.

Since the Devonian wells will flow and the Clearfork must be lifted, the installation at the time of workover is normally as follows: On the Devonian, or long string of tubing, a gas-lift side-pocket mandrel is made-up just above the dual packer. A seating nipple is set above the mandrel, and additional side-pocket mandrels are spaced on up the string to within 1,200 feet of surface.

All mandrels are initially equipped with dummy valves. As wells cease to flow, dummy valves are pulled and live valves installed. In addition, a string of 1-inch tubing is run with a pack-off and hung from the seating nipple as shown in Figure 3. It is necessary to run the string of 1-inch tub-

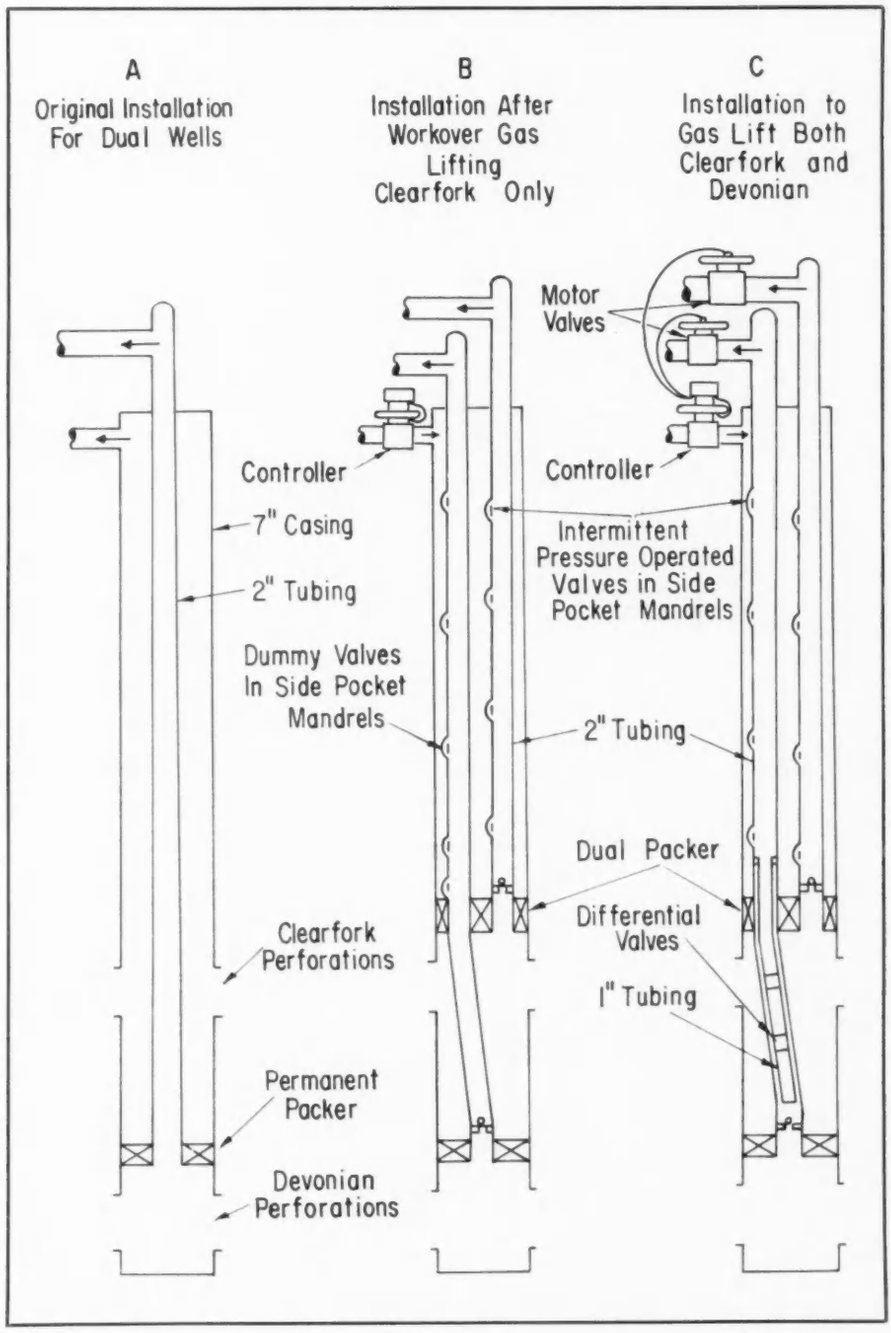


**FIGURE 3—All three types of dual completions shown here have been used at Dollarhide. The single string installation (A) was used initially, but is being replaced during workovers with the twin string hookups shown in (B) and (C).**

**FIGURE 4—This well would not flow prior to workover. Additional zones were perforated and acidized; gas lift equipment was installed. The curve shows production prior to workover was 7 bopd; after workover, 31 bopd.**

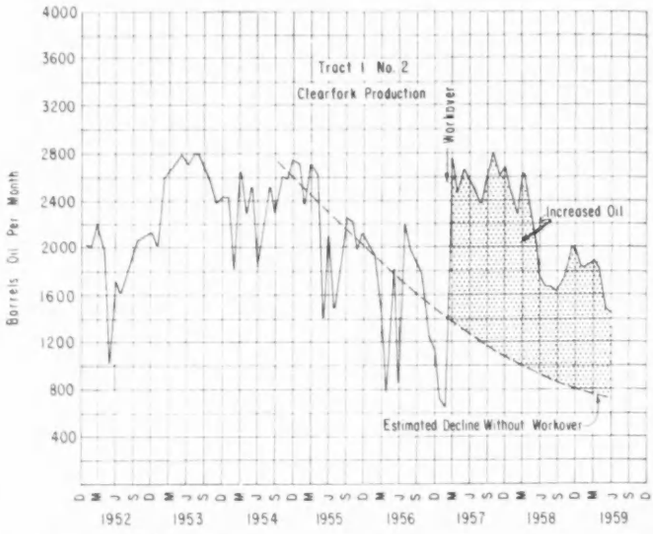


**FIGURE 5—Clearfork production from this well averaged 40 bopd with a GOR of 2295/1 prior to workover. After perforating additional intervals and fracturing with fresh water, the well potentialed 101 bopd with a GOR of 1628/1.**

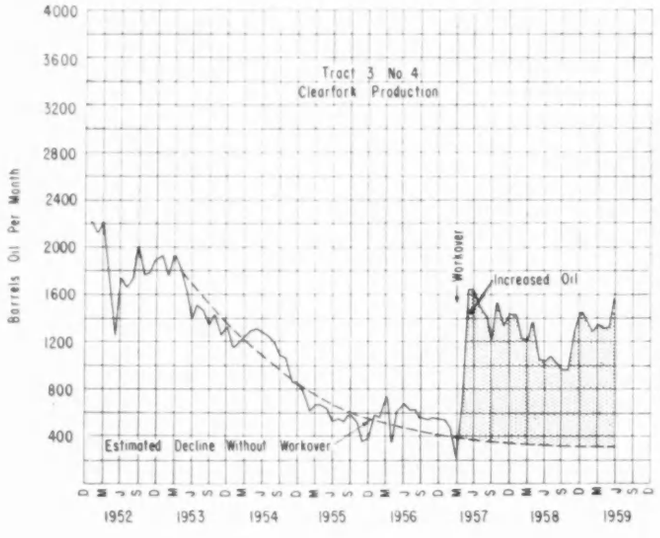


**FIGURE 6—This well averaged 14 bopd from the Clearfork prior to workover. After extending perforations and performing sand-oil fracture job, the well potentialed 105 bopd with a GOR of 1218/1.**

ing so that the point of gas entry will be below the dual packer and operating fluid level.

**Case histories.** Figures 4, 5 and 6 show production curves of three different wells on which workover jobs were performed. All three wells had additional zones opened in the Clearfork, but each was treated in a different manner.

The well in Figure 4 was treated with 15,000 gallons of 15 percent HCl acid, the well in Figure 5 was fractured with 45,000 pounds sand and 45,000 gallons fresh water and the well in Figure 6 was fractured with 45,000 pounds sand and 45,000 gallons of lease crude. Both fracture jobs were performed in three stages, while the acid treatment was single staged.

A comparison of the curves shows that all three treatments have maintained production above that prior to workover. However, it appears that fracturing resulted in a greater production increase than the acid job. This held true in the comparison of all workovers, and as a result, sand-oil fracture treatments have been standardized for all Clearfork stimulations.

Cost of a workover in the Dollarhide field has averaged approximately $30,000. This includes installation of all new equipment and treating. A normal payout ranges from six to eight months based on earnings from increased oil only. The installation of two strings of tubing which prepares the lower zone for lifting at a later date costs approximately $2,000 at the time of workover and about $2,000 more at the time the well is placed on artificial lift. It is calculated that this procedure will save about $5,000 over the cost of waiting and installing all the equipment when the well would no longer flow.

This manner of working over wells has proved very successful and with slight changes has been used on dual completions of new wells in the Fullerton Clearfork and Fullerton San Andres fields of Andrews County, Texas. —The End

## About the Author

**Earl H. Furrey, Jr.,** attended the University of Oklahoma where he majored in industrial engineering and management. He was employed by Cities Service Oil Company in 1952 as a junior engineer and later served as a petroleum engineer at Pampa, Texas; Madison, Kan., and Hobbs, N. M. He is now district engineer for Cities Service at Hobbs. He is a member of API and the Society of Petroleum Engineers.

# New perforators ease slim hole completion problems

**Unique, small OD guns are applicable to tubingless completions, upper zones of conventional multiple completions and deep wells with hydrostatic pressures from 10,000 - 20,000 psi**

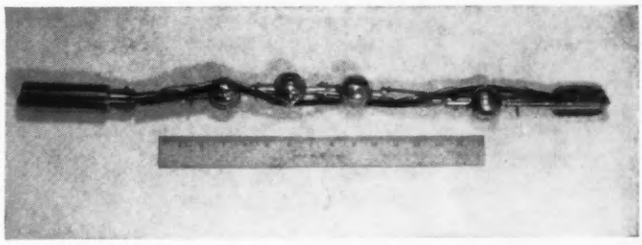

**FIGURE 1—This expendable and nonretrievable perforator is one of several types used to perforate tubingless or slim hole completions. Guns of this type have pressure ratings of 10,000 - 20,000 psi.**

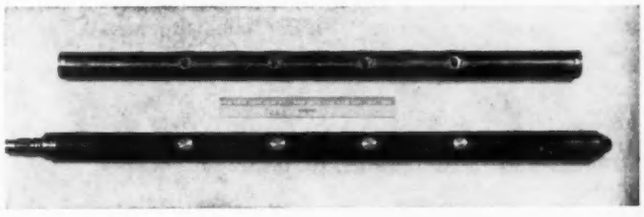

**FIGURE 2—The expendable and retrievable gun may be used to perforate tubingless completions or upper zones of conventional multiple completions. The hollow steel carrier can withstand pressures as high as 20,000 psi. Also, the carrier absorbs much of the blast energy of the charges and retains debris which remains after firing.**

**By Pete DeFrank,**
Manager of Research,
Jet Research Center, Inc.
Arlington, Texas

INCREASED USE of slim hole drilling methods and the practice of setting small diameter pipe or tubing as casing has resulted in development of perforating tools which provide maximum penetration with minimum debris. Such completions require miniaturized perforating tools which will perform comparable to standard sized equipment, but under more difficult conditions. This article discusses a number of perforating problems resulting from slim hole operations, together with methods and tools which have been developed to meet these problems.

**Definition.** Slim hole or tubingless completions may be defined as utilization of small diameter casing in oil or gas wells. The practice does not necessarily include a reduced size hole. Although the use of small casing permits the drilling of a smaller hole, it may not be economical to do so when the contractor is not properly equipped or where formations are not suitable.

In tubingless completions, where 2⅞-inch OD tubing is set as the production string, it still is current practice to drill 6¼-inch hole below the 7-inch surface casing seat. In some wells, hole size is reduced to 5⅝-inch through the pay zone to reduce thickness of the cement sheath and allow greater shot penetration into the formation.

For multiple tubingless completions, it is common practice to drill 8¾-inch hole beneath the 9⅝-inch surface casing seat. The procedure will become even more attractive economically when drilling techniques and smaller equipment are developed to permit efficient drilling of small sized holes.

**Perforating specifications.** Reduction of casing size necessitated design of small, highly efficient perforators, since perforating specifications for slim hole completions are more severe than for conventional or permanent well completions. These specifications are as follows:

**1.** Perforations must be free of gun debris, and permit a clean unobstructed flow channel into the wellbore. Productivity should be comparable to conventional size perforators.

**2.** Sufficient penetration must be obtained through casing, cement and contaminated formation to establish communication with the undisturbed reservoir. Excessive cement sheath resulting from setting small pipe in conventional size drilled holes, together with the restricted space inside the small diameter pipe in which the perforating tool is run, aggravates this problem.

**3.** Hole size in the casing must be adequate to permit fracturing with excessive casing pressures.

**4.** Perforating tools must be designed to withstand the extreme hydrostatic pressures of wellbore fluids. One operator drilled a 4-9/16-inch hole from 16,500 feet to 19,500 feet with 17.6 ppg mud. Hydrostatic head was equivalent to approximately 18,000 psi at TD.

**5.** It is desirable that little or no debris remains from the perforator to cause bridges in the pipe or malfunction of tools and equipment.

**6.** Perforating guns and associ-

FIGURE 3—Here is a cross-sectional view of the expendable and retrievable perforator. Five and one-half grams of explosive are contained in each charge.

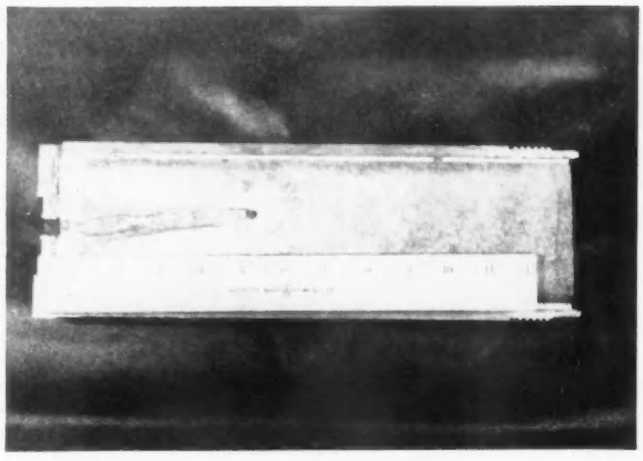

FIGURE 4—The 1⅞-inch OD expendable and retrievable gun penetrates approximately 5½-inches of a standard Berea target under well conditions.

ated equipment must be retrievable through restricted landing or seating nipples (1.781 inch ID for 2⅜-inch tubing and 2.250 inch ID for 2⅞-inch tubing).

## TYPES OF PERFORATORS

Two basic gun designs are used for perforating slim hole completions: the expendable and nonretrievable types such as those originally designed for through tubing work in permanent well completions, and the expendable, yet retrievable, types. Both designs meet, as nearly as possible, the previously listed specifications.

**Expendable-nonretrievable.** Figure 1 shows one design of the many types of expendable and nonretrievable perforators available. Charges are hermetically sealed from wellbore fluids and pressures, and are usually linked together by a pin and box type connection. Blank interval bars are available to allow the skipping of intervals as desired.

In this design, the OD of the tool is limited by the ID of the casing. For 2⅜-inch OD tubing (1.99-inch ID) and 2⅞-inch OD tubing (2.441-inch ID) set as casing, a 1-11/16-inch (1.688-inch) OD and 2⅛-inch (2.125 inch) OD perforator, respectively, have been found satisfactory. Guns with too large an OD would be difficult to run, particularly in crooked pipe. Those with too small an OD would necessarily contain smaller and less powerful charges.

This type perforator must be equipped with charge cases strong enough to withstand extreme hydrostatic pressures (which result in more debris), yet have good frangibility to leave debris of small particle size. Various designs of expendable and nonretrievable perforators with explosive loads of from 10 to 15 grams for the 1-11/16-inch size and 15 to 19 grams for the 2⅛-inch size are available.

It should be made clear that charge performance is not a direct function of explosive weight, but a function of design. In other words, effective utilization of explosive is more important in obtaining good performance than is the amount of explosive. Perforators of this type have pressure ratings of 10,000-15,000 psi.

Expendable type perforators have the advantage of flexibility and maximum penetrating performance, with the disadvantage of leaving debris which can be objectionable due to fouling of packers, plugging of flow valves, etc. If desired, a caustic solution can be spotted over the debris to dissolve or reduce fragment size. Field tests have indicated that well cemented casing of minimum size is not damaged by these perforators.

**Expendable-retrievable.** Figure 2 shows an expendable and retrievable type perforator. A 1½-inch OD perforator with a 3-gram charge has been developed for use in 2⅜-inch OD pipe and a 1⅞-inch OD gun with a 5½-gram charge is used in 2⅞-inch casing. In this design, charges are enclosed in a hollow steel carrier which will withstand hydrostatic pressures in excess of 20,000 psi before perforating. This hollow carrier also absorbs much of the blast energy of the charges, thus protecting the pipe and formation, and permitting retrievability of the expendable carrier through the restricted diameter landing nipples.

Figure 3 shows a cutaway view of a charge loaded in place in the hollow steel carrier. This particular charge contains 5½ grams of high explosive and, as shown in Figure 4, obtains approximately 5½ inches of penetration in a standard Berea target under simulated well conditions. The 3-gram charge used in the 1½-inch OD perforator will obtain about 3½ inches penetration under similar conditions.

A strip charge holder permits a shot density of from one to four shots per foot, and charges can be arranged so that all fire in the same direction, or at 180° phasing. The gun carrier is notched on the outside, at each charge position, to reduce the wall thickness which must be penetrated, thus resulting in increased effective penetration. Pressure tests indicate the small area of these notches does not weaken the carrier.

The expendable and retrievable tool has the advantage of being a debris free perforator, since the expended charge and chargeholder debris is retrieved with the spent gun carrier. Also, the detonating system is enclosed in the gun carrier, and is not subjected to wellbore fluids and pressures. Damage to casing or cement sheath is prevented since the carrier absorbs the explosive shock of the charges. Although these guns are primarily applicable to both single and multiple tubingless completions, a secondary, yet important, application is the perforating of liners in deep wells with heavy mud where difficulty has

been experienced in getting down with conventional carriers.

## GUN ORIENTATION TECHNIQUES

Multiple tubingless completions, with two or more strings of tubing cemented in the same bore hole, presented additional problems. Since it was necessary to perforate upper zones without perforating the adjacent strings of pipe, exact orientation of the gun was required.

**Mechanical.** In the mechanical orientation system, the upper tubing strings carry an eccentric mandrel above each zone to be perforated. The orienting device, containing a spring-loaded arm to orient with the maximum eccentricity of the mandrel, is run on the gun. Thus, shots are directed away from the other strings of tubing. In some guns, shots are fired in the same vertical plane; in another type, shots are at 30° phasing.

The disadvantage of this system is that each potential productive zone to be tested must have an eccentric mandrel properly spaced out when the tubing string is installed initially. Also, all strings must be clamped and run together so as to maintain the exact position of each mandrel with respect to the other strings of tubing.

**Radioactive methods.** These disadvantages were largely overcome by development of an orienting device employing radioactive materials. With these devices, no preplaced mandrels are required and multiple casing strings may be run independently, rather than as a unit or cluster.

This type orienting device incorporates a focused radioactive source rigidly fixed to the perforating gun. A gamma-ray detector is run in the adjacent string. A mechanical device inserted above the gun can be rotated in 30-degree increments by reciprocation of the wireline. Readings from the gamma-ray detector are recorded at the surface. Increased radioactive peaks are recorded when the focused source and gun are in line with the detector, and minimum peaks are recorded when the source and gun are rotated 180 degrees from the detector in the adjacent string. In this way, the gun can be rotated until the detector indicates that it is pointed away from the adjacent string. In other types of multiple completions, it is necessary to run the detector in each string to establish their position.

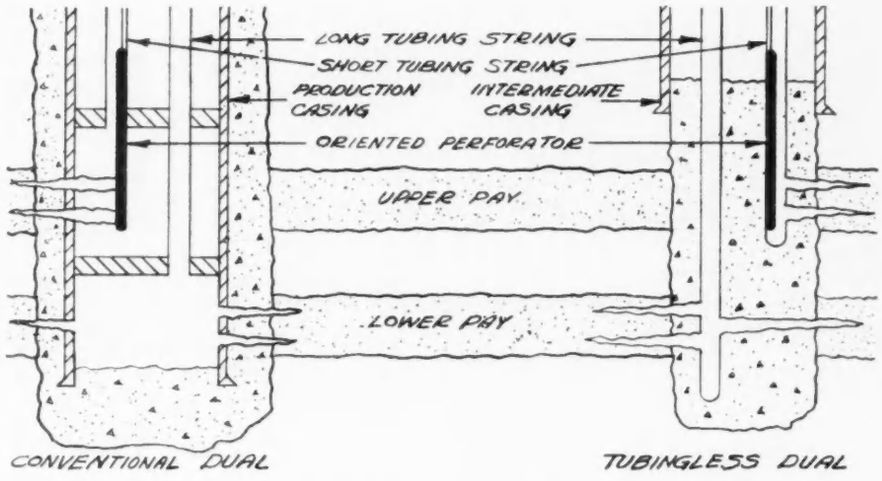


**FIGURE 5—Expendable and retrievable guns can be used to perforate the upper zones of conventional multiple completions without pulling pipe, as well as multiple tubingless wells.**

While the previously described radioactive orienting device offered advantages, the necessity of a source and detector in adjacent strings of casing was time consuming and required service equipment to run two separate conductor cables. This problem has been solved with the development of another type of radioactive orienting device. This tool contains both source and detector, and is run in the same string at the same time as the perforator. Thus, only a single run is normally required to complete the job.

**Other applications.** The expendable and retrievable perforator also has made possible the penetration of the upper zone in a conventional multiple completion without the expense of killing the well and pulling tubing. In this type of completion, the perforating problem is aggravated since the long string of tubing is not protected by cement. When perforating the upper zone, the gun must be oriented to shoot away from the long string since it is essential that the pipe remain undamaged by the blast effect of the gun.

The expendable and retrievable gun can be oriented by means previously described and the gun carrier absorbs the blast energy of the charges to prevent damage to the adjacent string of tubing—even in the extreme situation where the perforator may be in direct contact with the pipe. New techniques and equipment currently under development will permit use of the more powerful expendable and non-retrievable guns in this type of completion. Figure 5 illustrates the method of perforating the upper zone of both the conventional dual and the dual tubingless completed well.

The development of more efficient small size bits together with rig equipment designed especially to drill small holes economically, should result in a still greater cost advantage to slim hole completions. This will ease the perforating problem since less cement sheath will have to be penetrated, resulting in more effective penetration.

—The End

**About the Author**

**Pete DeFrank** was graduated from Texas A&M College in 1948 with a B.S. degree in chemical engineering. He worked for Humble Oil & Refining Company in drilling, production and well completion assignments until 1955. He then joined Jet Research Center, Inc., with assignments in research and development of shaped charges. He was appointed manager of Research in 1958.

# How to use the continuous velocity logger in core and shot holes

## Efficiency boosted; seismic geologic work combined through use of shallow velocity data

**By H. W. Hardy,** Research Geophysicist
Humble Oil & Refining Company, Houston

THE CONTINUOUS VELOCITY LOGGER has become popular both as a geological and geophysical tool. The core hole—shot hole velocity logger has proved valuable both to geologists and geophysicists in the Humble Division's operating territory.

**Equipment.** Basic differences between deep- and shallow-hole instruments are relatively slight. In working with small-diameter holes, the first consideration must be the physical dimensions of the logging sonde. Though there is considerable controversy as to the hole size to be labeled a "core hole," the sonde should be small enough to operate in holes of five inches or less in diameter. The down-hole tool now in use has a diameter of 3⅜ inches and a length of about 16½ feet. This instrument is seen in comparison with a deep hole logging sonde in Figure 1.

**The relative sizes of sondes** are significant. The core hole tool consists of four parts, two of which are of an electronic nature. In descending order, these parts are cable head, electronic cartridge, acoustic section and weight. The assembled logging instrument weighs about 350 pounds.

Size and weight of the present logging sonde are not considered to be completely satisfactory. Effort is continuing on redesign which will result in a down-hole tool having a diameter of 2½ inches, a length of approximately 10 feet, and an assembled weight of less than 200 pounds.

In keeping with the idea of small hole work and its frequent use as a reconnaissance technique, the core hole logger was designed and completed as a single unit. That is, the logger on its vehicular mount is highly mobile and self-sufficient. After arriving at the hole, it is capable of performing the entire operation.

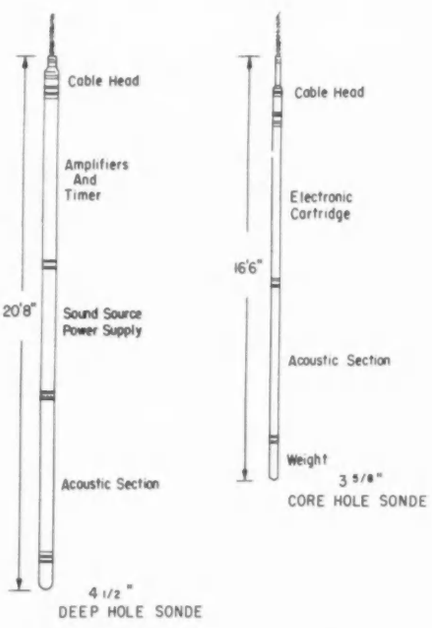


**FIGURE 1—This diagram shows deep hole continuous velocity logger sonde (left) and smaller, more compact core and shot hole counterpart (right). Efforts continue toward development of smaller diameter, lighter small-hole equipment.**

The logger is mounted on a four-wheel drive truck. The especially-designed instrument cab houses the surface electronic equipment, well logging camera, cable handling reel, sondes and accessories. Details of the outfit are obvious, i.e., instrument cab entrance, storage bins, some accessories and location of the hydraulically-controlled cable reel.

Core hole velocity logging equipment is compactly housed in a conventional motor truck. Cable reel, sonde storage racks, cable level wind and measuring wheel, cable supporting sheave, wheel chocks, power generator, and other similar equipment are housed together. The arrangement for cable handling is standard in almost all respects. Recording of down-hole signals is done with a small well-logging camera which uses light beams reflected from galvanometer mirrors to make the traces on conventional logging film.

The core-hole sonde shown in the right-hand side of Figure 1 has two water-tight, pressure-proof couplers

connecting the three basic parts of the logging took, i.e., cable head, electronic cartridge, and the acoustic section. A stiffener is also used, to protect the flexible acoustic section during handling and assembly of the tool. The stiffener is removed before the logging run is made. The rest of the sonde is housed within 3⅝-inch OD casing.

**How it works.** The basic principle of operation is almost identical to that of the deep hole logger. For simplicity's sake several operations performed within the sonde of the deep hole tool are accomplished in the surface electronics of the core hole logger. This is possible because of the shorter cable length required in shallow hole logging and the resultant decrease in attenuation of the signals from the down-hole tool.

The velocity logging process is presented schematically in Figure 2. Within the timer, the pulse triggering of the input to the sonde's sound source is accomplished. These pulses of electrical energy are transmitted to the sound source in the acoustic section and in that source are changed from electrical energy to sound. Sound travels via the shortest time path (normally through the formation) across the 3-foot source-to-detector spacing and the 1-foot detector-to-detector span of the acoustic section. Detectors within the acoustic section receive the pulsed sound and convert it back to electrical energy. These signals are transmitted to the surface for timing and subsequent recording, thus completing the continuous velocity log.

The resulting velocity log is exhibited next in Figure 3. Traces included on the log are the Δt trace and the base line of the recording system. The base line or "zero" represents the recording galvanometer in its "rest" position. Signals which actuate the recording galvanometer are developed from the measurements made in the bore-hole and are related to the interval velocity of the formations. Movement or deflection to the left is controlled by the interval velocity of the particular part of the bore-hole wall opposite the two detectors. This deflection is scaled in microseconds; therefore, the more deflection, the larger the travel time in microseconds

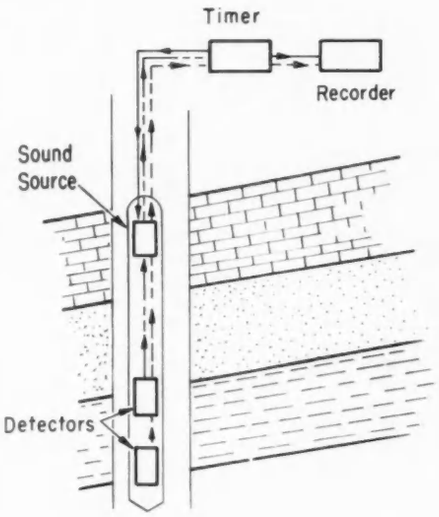


**FIGURE 2—This diagram schematically shows the velocity logging process described in the text.**

and the lower the velocity. Seen on this sample log are the characteristic curves of sands, shales, anhydrides and beds containing varying mixtures of these rock forming materials. Of interest in this illustration is the detail or resolution obtained by using a "fast" galvanometer in conjunction with the 1-foot spacing between detectors.

By using a rolling planimeter, the log may be integrated and travel times established for various intervals of logged depth. These travel times may be combined with tie or check shots obtained in a modified geophone shooting survey to determine vertical travel times, average velocities and interval velocities to and through the earth's layers.

**Correlations.** The core hole velocity log gives the exploration geologist a log which has proven to be an effective, correlation tool. Core hole velocity logs, SP-resistivity logs and gamma-ray logs of two core holes drilled in the western area of the Humble Division are presented as Figure 4. The velocity logs which appear on the left are easily correlated due to their identifiable curve character. Markers A, B, C, D and E are easily picked and correlated from the velocity logs. These same markers are labeled on the electrical and gamma-ray logs which comprise the remainder of the illustration. These

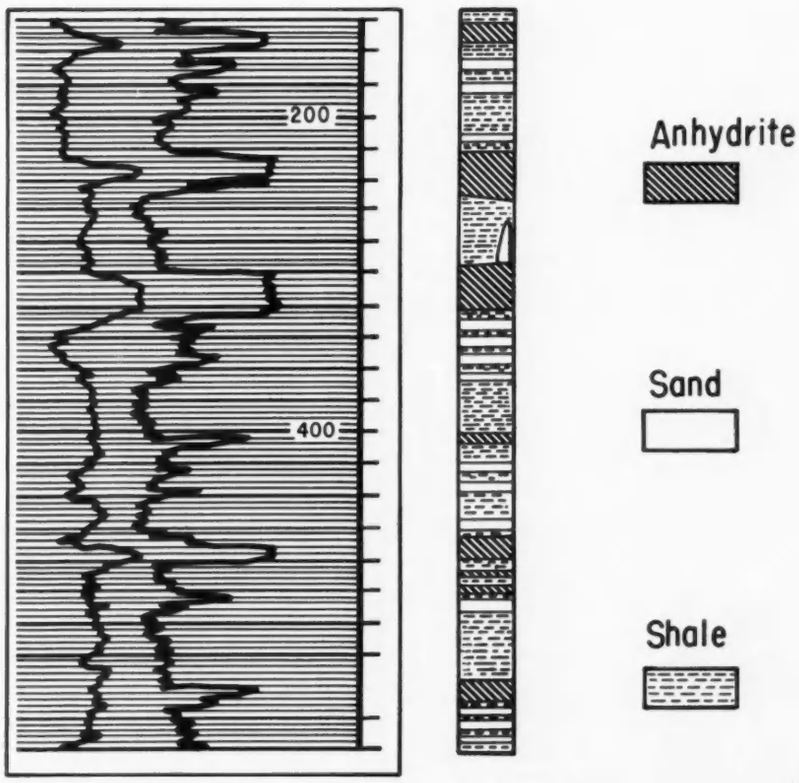


**FIGURE 3—Small-hole continuous velocity log shows detail resolution of lithologic breaks.**

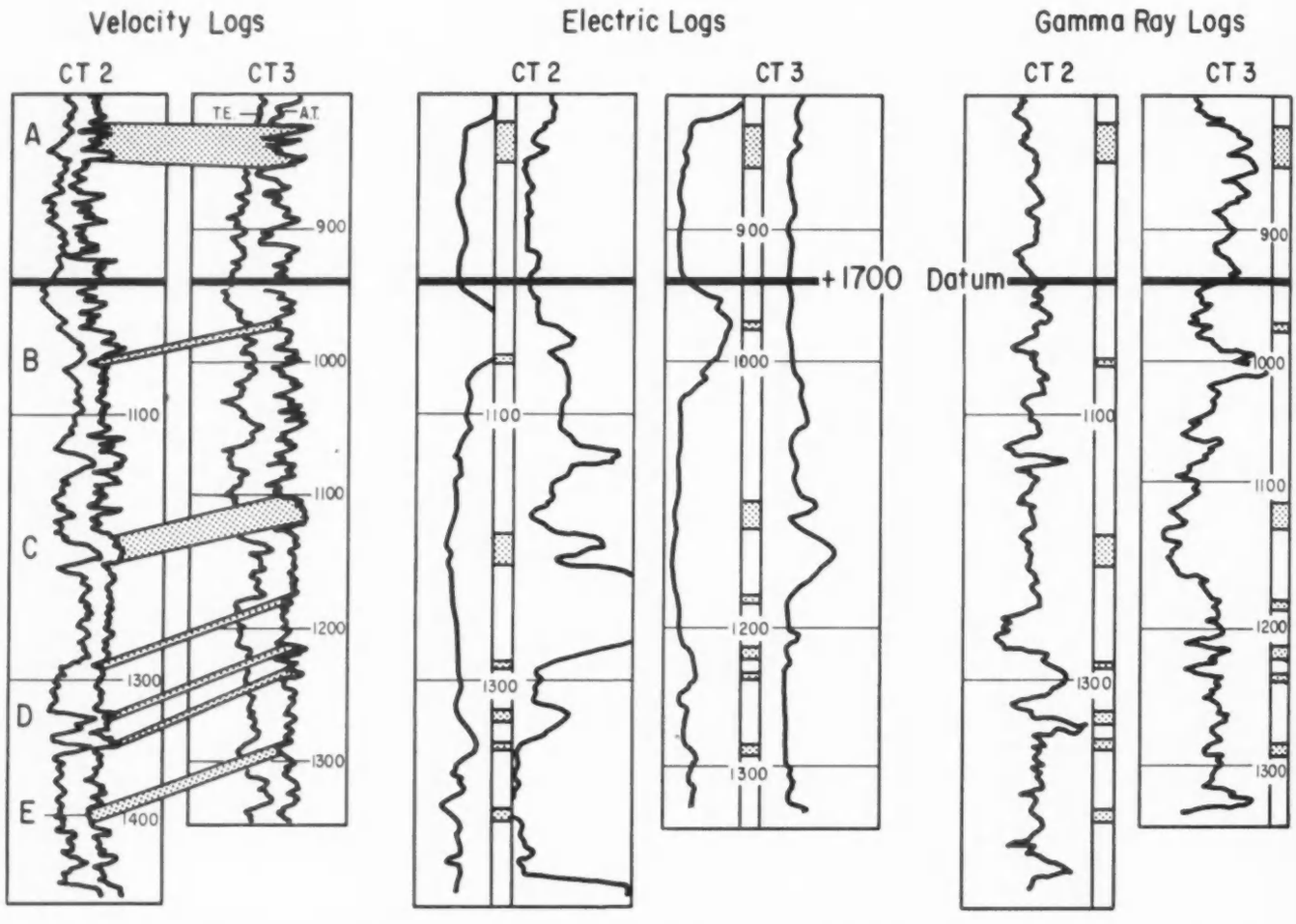


**FIGURE 4—Velocity logs provide good correlations two miles apart because of sharply defined curve characteristics. Electrical and nuclear logs were run in the same holes.**

core holes are located about two miles apart in an area where *near-surface steep dip is normal.* Core hole velocity logs are considered reliable for correlation purposes.

**Velocity surveys.** In addition, small-hole velocity logs are valuable for velocity data *per se.* One of the main sources of error in geophysics exists in assumptions about the near-surface low velocity layer (LVL). In a new area, one of the first projects is to shoot an uphole survey to obtain more information about the LVL. This operation may be repeated at various intervals depending on location, time, or other criteria, but it is seldom continuous from hole to hole. If there is any reason to expect that a specific core drilling area will become a shooting prospect, additional velocity information is highly desirable. Often in normal reflection shooting, difficulty is encountered in making record corrections fit as progress is made down a shooting line. The availability of a shot hole velocity logger provides geophysical computers with the additional information needed for satisfactory corrections and to accomplish difficult time ties.

**Field operation** of the shot hole velocity logger does not present any major problems. If the crew employs two drills, one is equipped with bits capable of drilling 5¾-inch holes. This means an increase from 4½ inches, but in rare cases does it excessively reduce efficiency of the crew.

Although this is so, the desirability of the smaller tool previously mentioned cannot be overemphasized. Equipping only one rig with this size bit will necessarily limit logging activity to alternate holes or one out of three. This coverage is considered adequate. Upon completion of the hole, the velocity log is run and the usual charge loaded. From the TSP (time shot point) geophone at the time of shooting, the vertical time from charge depth to surface is obtained and recorded on a high-speed seismic camera. Since the shot holes are normally relatively shallow, experience shows that one tie shot is sufficient. If charges are subsequently loaded at shallower depths, the vertical times resulting from them may be used as check shots.

The process of obtaining shot times in core holes is very similar to this technique. To avoid delay and rig standby time, it has become practice to shoot in these holes and to record with a surface geophone. This eliminates the need to remove the velocity logging tool from the cable and to

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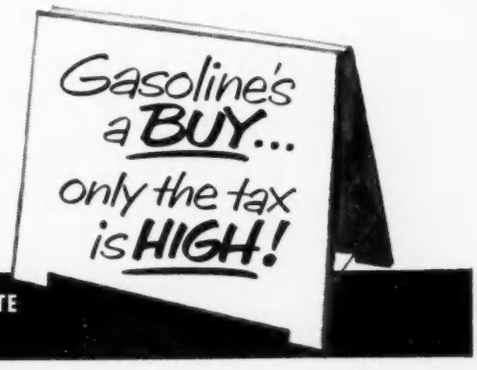


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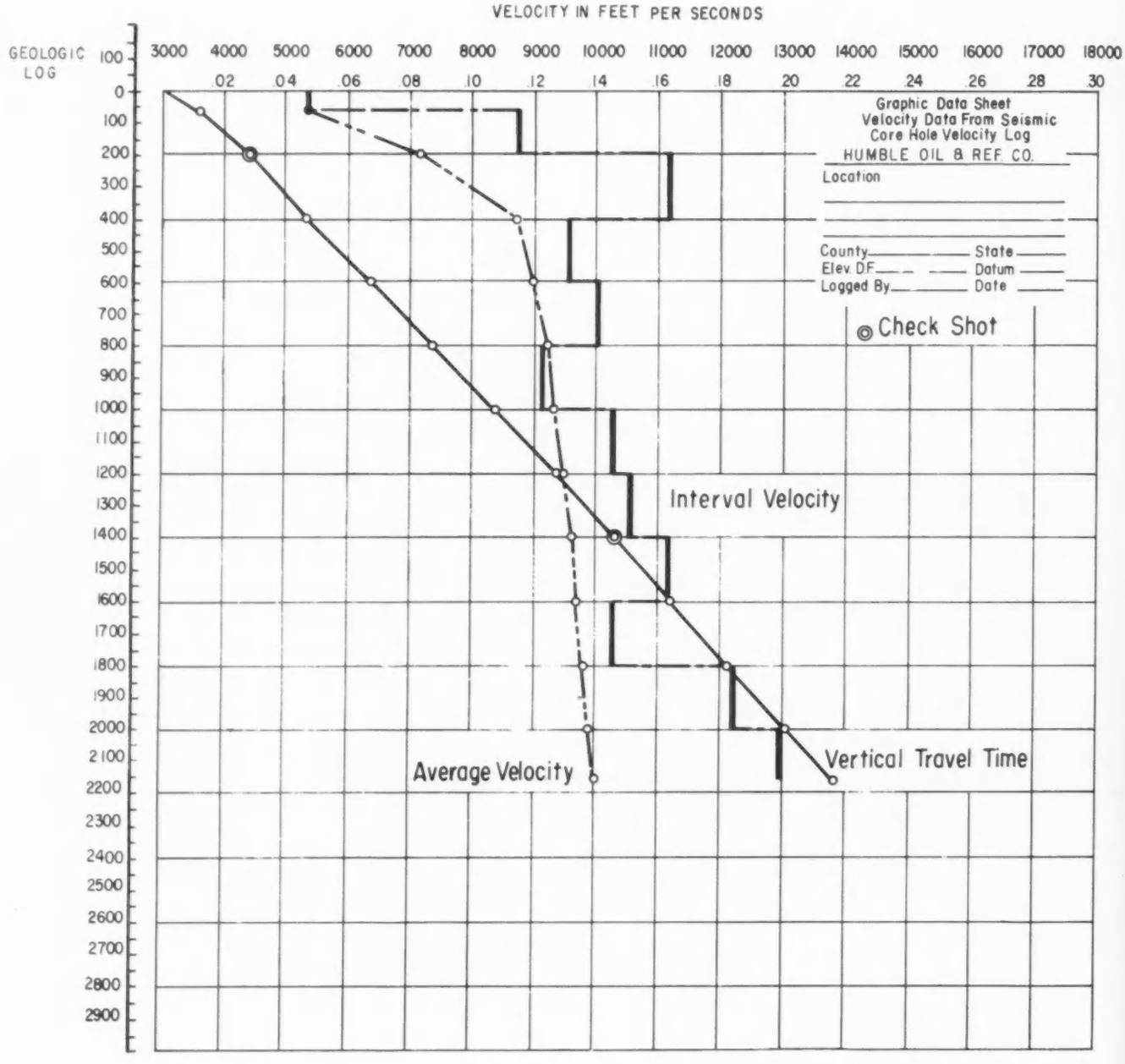


**FIGURE 5—Graphic data sheet has expanded scale specifically for shallow holes and greater detail.**

replace it with a well geophone. Holes up to 1,000 feet in depth can be logged and shot in approximately 1¼ hours.

**Results of check-shooting** are computed in accordance with normal procedure utilizing standard notations as carried on the Southern Seismic Well Shooting Association Well Velocity Calculation Form. The velocity log is then integrated by using a rolling planimeter and the results are combined with the shooting data on a Continuous Velocity Log Computation Sheet. From this sheet, the core hole or shot hole Graphic Data Sheet is prepared. A sample copy of a core hole Graphic Data Sheet is included as Figure 5. This expanded scale is specifically for the shallower holes and lends itself to greater detail. The standard notation for depth, velocity in feet per second and vertical travel time in seconds below datum are carried on this form.

Upon completion of the Graphic Data Sheet, the entire survey, including copies of the velocity log, is delivered to the seismic computer. It then becomes the problem of that individual to choose the desired method to utilize the data. The preparation of average velocity or vertical time maps to specific depths may be employed to extend the velocity coverage over the entire area of interest. In some areas the most feasible solution is the determination of an acceleration factor and its application to the velocity problems.

**A specific example** in which incorrect velocity assumptions resulted in erroneous corrections is illustrated graphically in the next two figures. In the area, the seismographer en-

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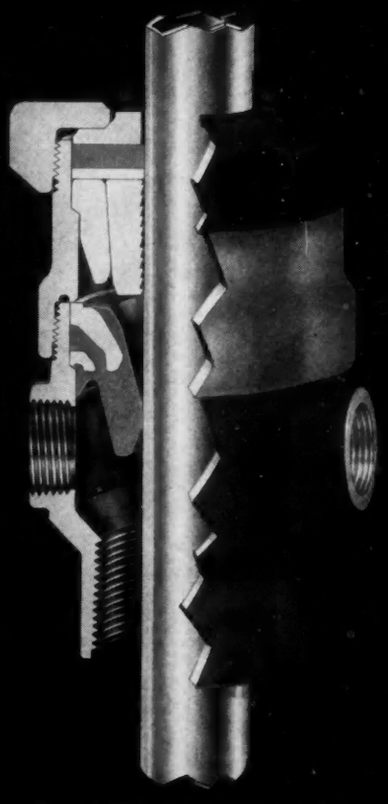

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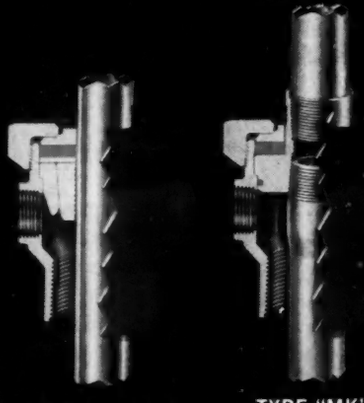

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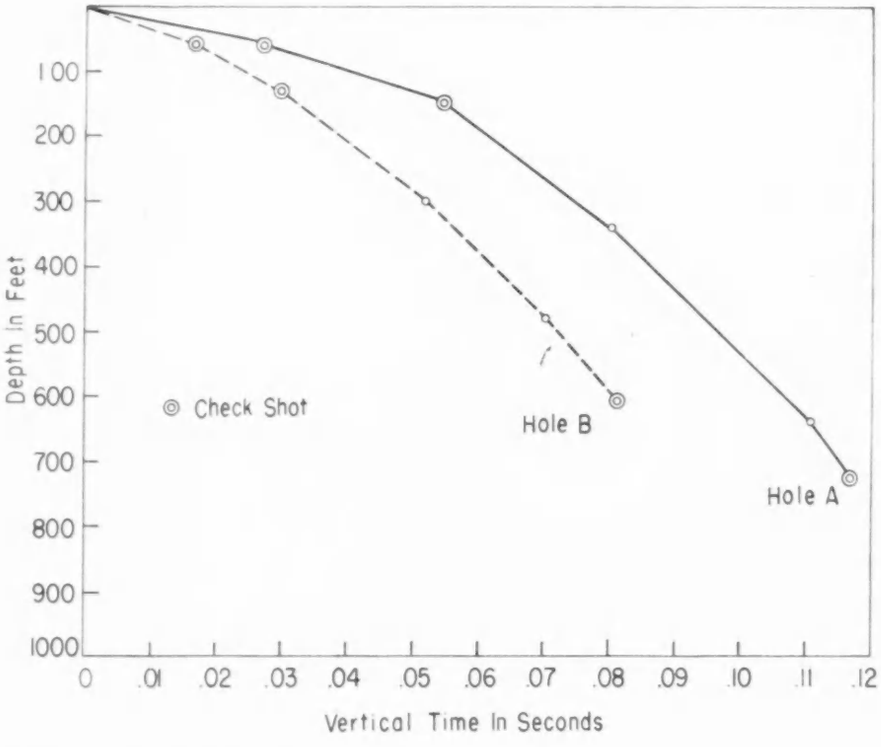


**FIGURE 6—These plots represent vertical travel times from the surface to the holes' total depths. Holes are 1½ miles apart horizontally and 114 feet different in surface evaluation. The higher hole is in caliche-cemented sand at the surface, the lower one in stream valley detritus.**

counters relatively abrupt elevation changes due to the presence of the West Texas "cap rock." The nature of outcrops of this cap-forming rock —buff colored, fine grained sand cemented by white caliche—led Humble computers to assume that when shooting on the cap, a higher average velocity must be used in making seismic LVL corrections to datum. The plots presented in Figure 6 represent vertical travel times from the surface to the holes' total depths. Hole A was separated from hole B by a distance of approximately 1½ miles and an elevation difference of about 114 feet. The lower elevation hole (B) was located in a broad valley floored with loose sand and detrital material from the "cap rock." The vertical time plot demonstrates very markedly the error in these assumptions.

Because of questionable geophysical data, the use of shallow pattern shot points and poor TSP response during the original shooting, there were computing errors significant enough to mask the true structural relationship of the deeper beds. This amount of incorporated error is shown graphically in Figure 7. The topographic relationship of the two holes are shown as well as the seismic datum and depth of subsequently drilled core holes. The cross-hatched portion of the figure indicates the amount of error, in feet, which the resultant time correction error created at or near the area's producing horizon. With an error in time of 0.030 second and an average velocity of 14,000 feet per second, the resulting 420 feet of error in depth approximation becomes apparent. The error at hole B is much less, as could be expected from the previously-exhibited vertical time curves.

Core hole or shot hole velocity logging service is not now available on an economically feasible basis commercially. However, recognition of the usefulness of a tool capable of making each shot hole or core hole a source of low velocity information

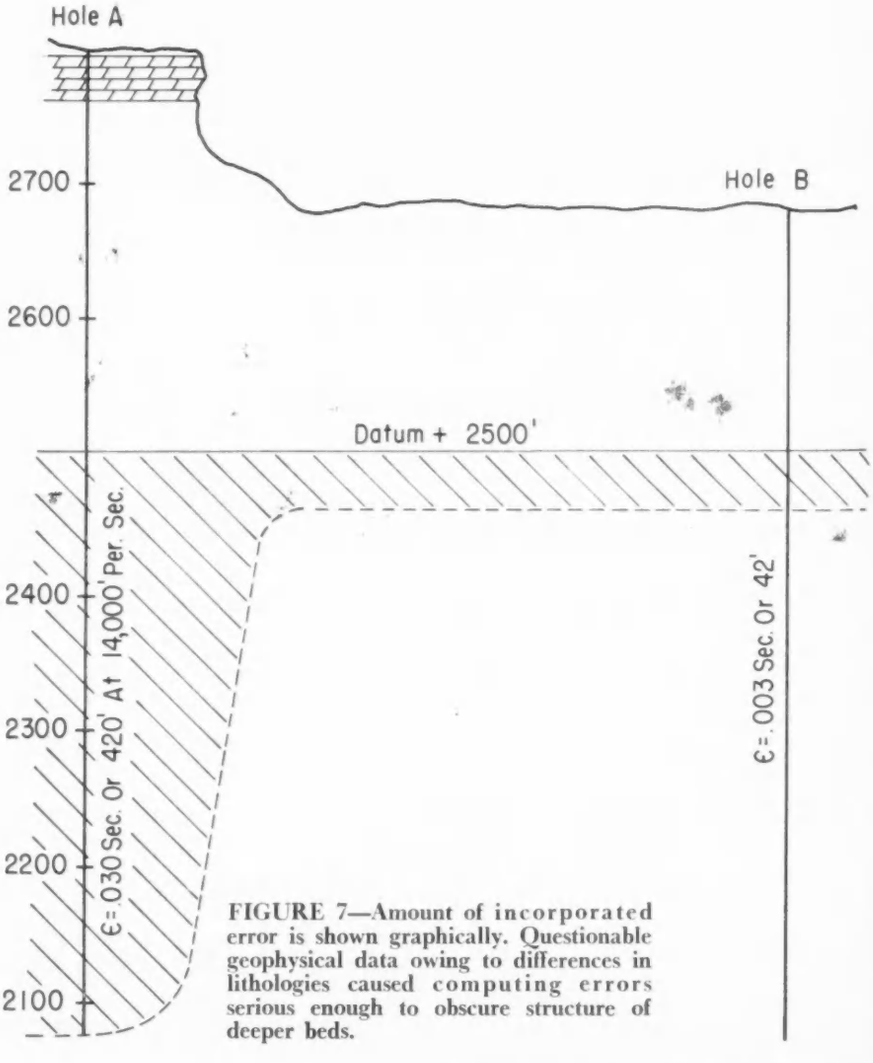


**FIGURE 7—Amount of incorporated error is shown graphically. Questionable geophysical data owing to differences in lithologies caused computing errors serious enough to obscure structure of deeper beds.**

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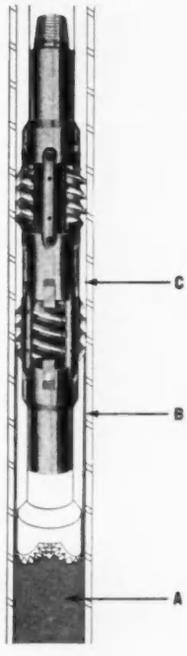


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This article is based on a paper presented at the Thirteenth Annual Midwestern Exploration Meeting of the Society of Exploration Geophysicists, Shreveport, La., on April 4, 1960.


BIBLIOGRAPHY

Hardy, H. W., "Continuous Velocity Logger Yields Excellent Results," WORLD OIL, 148, No. 5, 111-117 and 137 (1959).

## About the Author

**Hugh W. Hardy** is research geophysicist with the Humble Division of the Humble Oil & Refining Company in Houston. Hardy attended the Georgia School of Technology and the University of Oklahoma, and received his B.S. degree in geological engineering from Oklahoma in 1947. The same year he was employed by Humble and assigned to an offshore geophysical crew working out of Galveston, Texas, and Grande Isle, La., before his assignment to the Houston office. After 19 months of military service in 1950-52, Hardy rejoined Humble and worked with the computing staff of the North Texas Division in Wichita Falls, Texas. In January 1957, he was transferred to the Geophysics Research Group at Houston. Hardy is a member of SEG, AAPG and the Geophysical Society of Houston.

### ERRATUM

Due to the inadvertent omission of the word "not" which is italicized in the corrected version below, an impression opposite to the one intended was created in the editorial published in WORLD OIL, August 15, 1960, page 9. The paragraph should have read as follows: "First, all nations agree that each country has the sovereign right to develop mineral resources on the continental shelf continuous with its borders and land mass. However, such right does *not* preclude the innocent passage of other nations' ships..."


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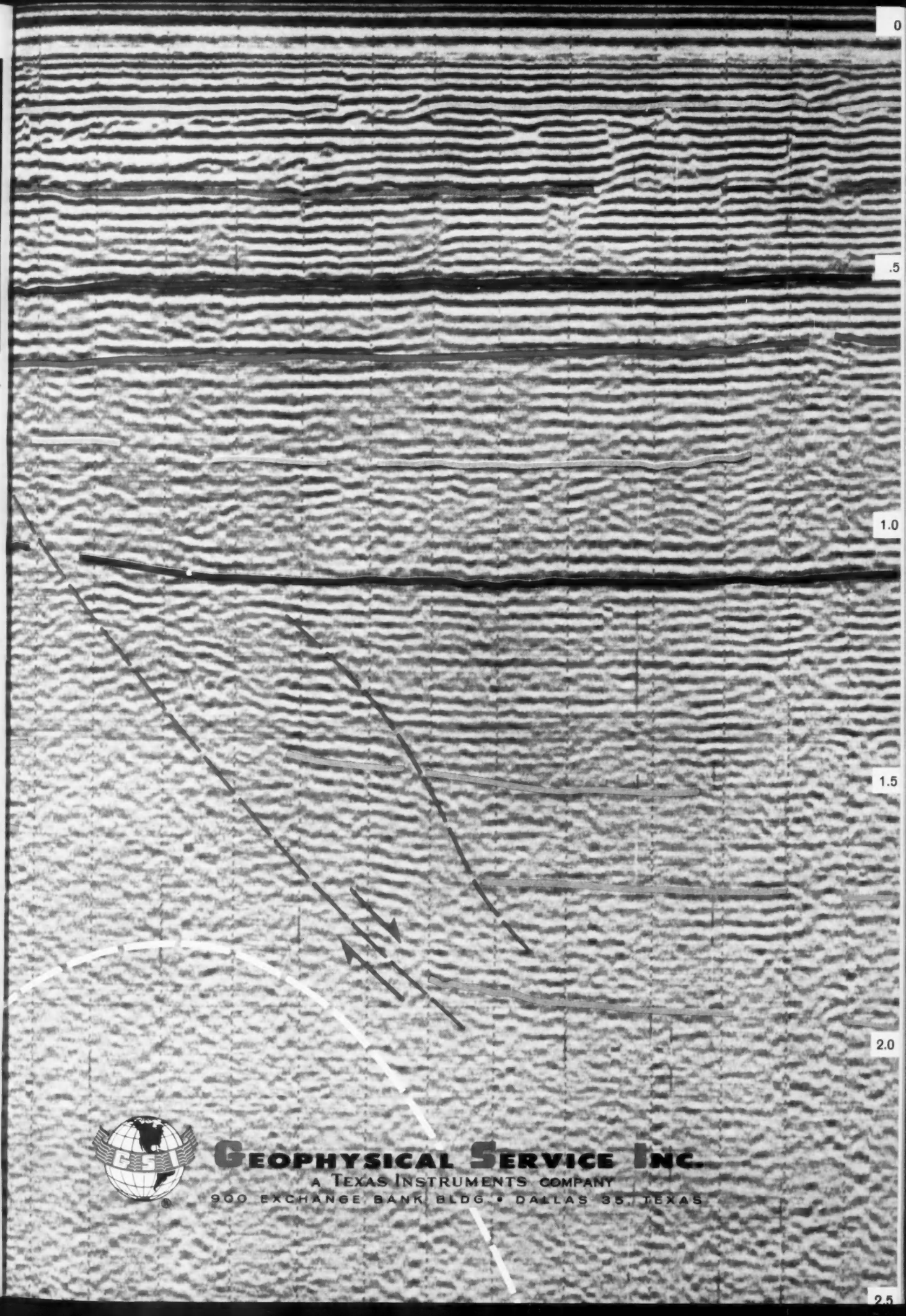
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tinuation of the Wichita Mountain Uplift of western Oklahoma, rises to its height in Potter County in the west central part of the Texas Panhandle, where Emerald Masterson 1 hit basement at 1,980 feet (plus 1,453). But in the same county, the basement falls off so abruptly that Standard Oil Company of Texas Bush 1, drilled on the flank of the Uplift, topped basement at 6,824 feet (—3,314).

Just south of the base of the Panhandle, the Palo Duro Basin is apparently deepest in Motley County, where Amerada Petroleum Corporation Birney 1 hit basement at 10,001 feet (—7,406). However, localized basement highs, one in eastern Motley County, and farther east on trend through Foard and Wichita counties along the Red River Uplift (which continues west of Motley as the Matador Uplift), elevate the basement as high as 2,305 feet (—921) at Roxana, Fain and McGaha Mathews 1, Foard County.

This North Texas trend of localized basement highs, reflecting the Red River Mobile Belt (a pre-Cambrian feature) continues eastward into Montague County, where a number of discoveries in "Granite Wash" and shallower beds have been made since 1950. Gravity anomalies, indicating basement conditions, have played an important part in most of these discoveries.

**The Matador Uplift** continues from below the base of the Texas Panhandle westward into New Mexico. A high well is Humble Jackson 1 in Lamb County, with basement found at 7,185 feet (—3,724). On the north end of the Midland Basin, Stanolind Argo 1 found basement rocks at 13,125 feet (—9,316).

Farther south in the Midland Basin, the basement may be very deep. Interpretation of existing data shows the basement as deep as —12,000 (about 15,000 feet), with steep dips pointing to a trough centered in Upton and Midland counties. The Central Basin Platform separates the Midland Basin from the Delaware Basin to the west. Several basement "hickies" rise above —5,000 on the Platform. Gulf Amanda 1, Lea County, New Mexico, hit schist at 7,330 feet (—4,013). The huge Delaware Basin, extending from Lea County southward almost to the Marathon Uplift is very deep (—16,000 feet in Lea County).

The Fort Stockton Uplift in Pecos County is a localized basement high north of the Marathon Uplift, rising to 4,518 feet (—2,002) in Gulf Garvin 1. The deepest Pecos County test to basement is Phillips Petroleum Company University 1-EE, which bottomed in Ellenburger at total depth of 25,340 feet. This test is the deepest well yet drilled in the Valverde Basin and in the world. The basement is believed to lie at about 26,300 feet

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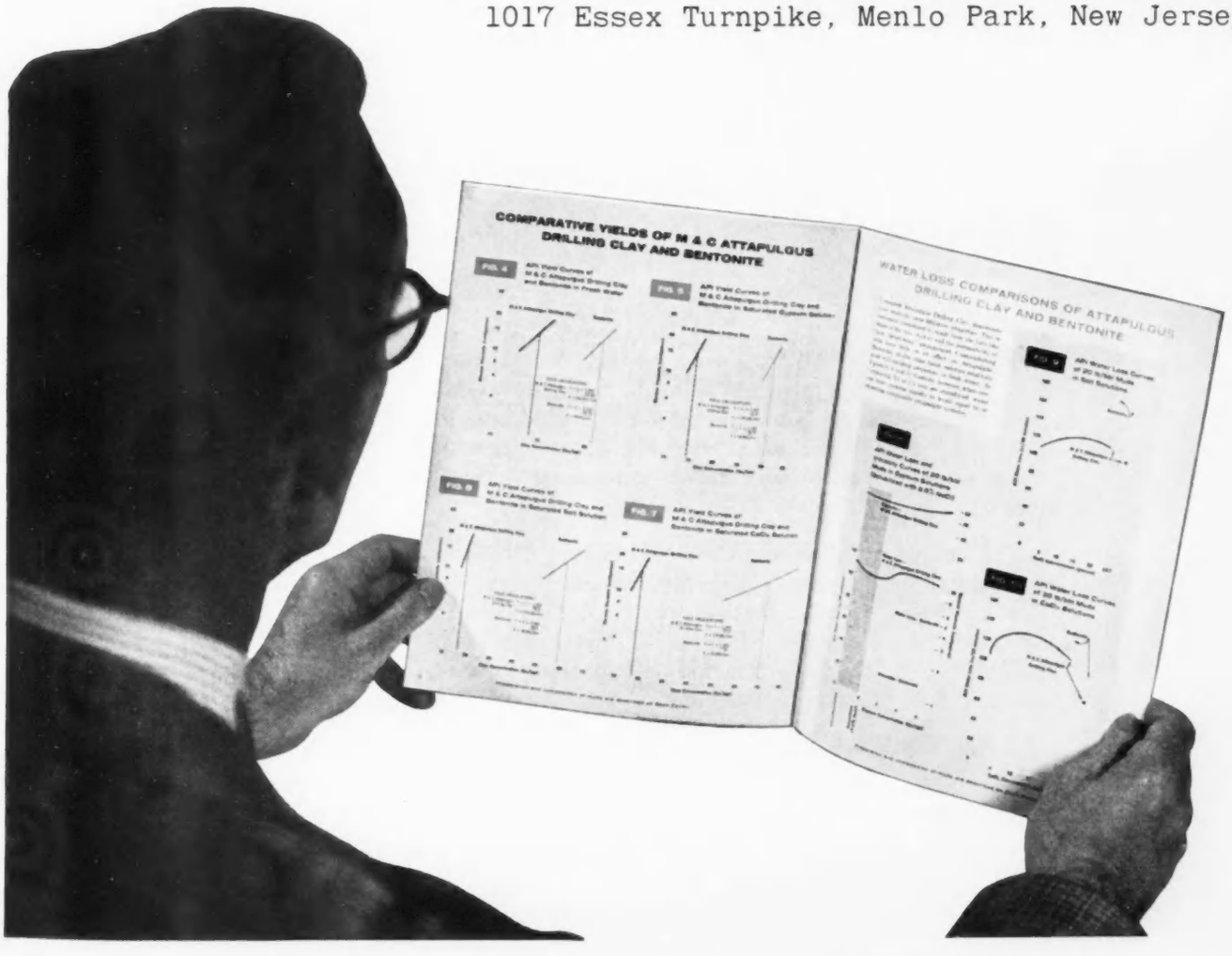
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at the 1-EE location. Only seven miles north of this test, Shell Oil Company (Humphries) University 1 hit basement at 4,809 feet (—2,189). This shows how abruptly the Fort Stockton Uplift rises from the great depths of the Valverde Basin.

The Eastern Platform, extending from the east edge of the Midland Basin eastward to the Llano Uplift and northward to the Red River Uplift, includes much of central Texas. A north-south fault zone shown affecting the basement in Coke and Nolan counties, just west of, and essentially parallel to, the Runnels County line, apparently bears on Wilberns sandstone (Cambrian) production. Humble 9 Oldham, shallowest Coke County basement well, got through the Cambrian at 5314 feet (—3299).

**The Ouachita** structural belt is a broad belt of deformed Paleozoic and metamorphic rocks that extends through Texas along a sinuous course from northeast to southwest. The front of the deformed belt extends goes through Dallas and Ellis counties, passes southeast of the Llano Uplift through Kendall and Bandera counties, and swings more nearly westward through Valverde County to the Marathon Uplift area. Viewed in cross-section, the frontal zone of the Ouachita belt on the northwest is composed of unaltered and very weakly metamorphosed Paleozoic sedimentary rocks. The interior part (to the southeast) is composed of highly sheared low-grade metasedimentary rocks of unknown age, such as are encountered in Luling field.

Along the western and northern edges of the Ouachita belt, there are several areas in which Ouachita facies rocks have overridden foreland rocks along overthrust faults (Grayson, Bell, Kendall, and Brewster counties).

Although failure to find production below Ouachita facies on certain closed structures (e.g., Luling) has long branded sub-Ouachita sediments with a "black eye" insofar as wildcatters are concerned, Ouachita facies *per se* do not necessarily represent basement. Unmetamorphosed sediments, e.g. Ellenburger limestone in Shell Purcell 1, Williamson County, have been found below Ouachita facies.

The south and southeast areal limits of this complex are not known, as Cretaceous beds get too deep to be drilled towards the Gulf Coast.

**In Kansas,** the famous Nemaha Ridge, a buried granite mountain range more than 165 miles long and up to 25 miles wide, extends from Nemaha County in the northeast to Sumner County in the south. The range in depth on the Ridge crest is from 1,175 feet in the north to more than 3,000 feet in south Kansas, and to as deep as 10,000 feet farther south in Oklahoma. Much oil has accumulated in sediments lapping up against the flanks of the Nemaha Ridge. East of the Ridge in northern Greenwood County, 650 feet of "schist pebbles" (driller's term for weathered schist?) was penetrated in one well, before actual hard schist was found at 4,150 feet.

In Rice, Barton, and Russell counties, oil has been found in stratigraphic


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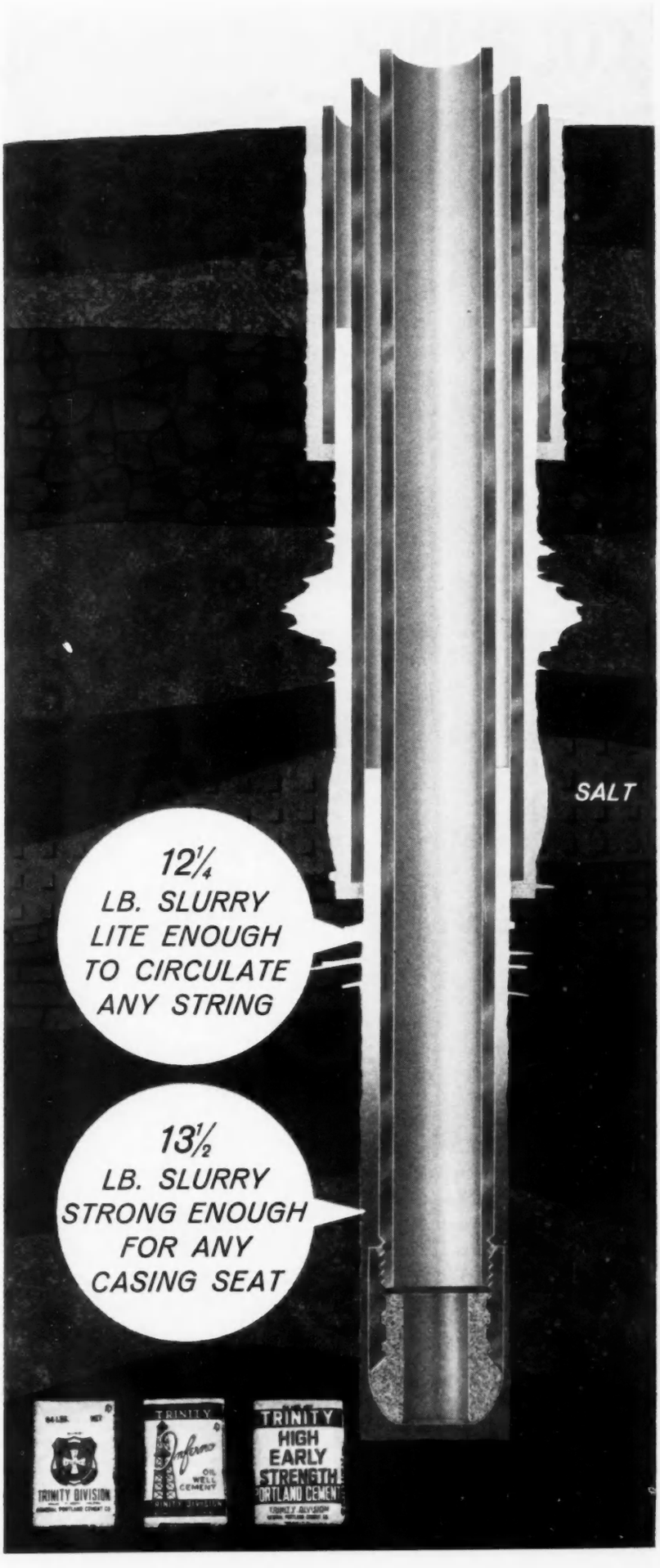


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The author is assistant medical director of E. I. Du Pont de Nemours and Co., Inc. Du Pont is well known for its efforts to rehabilitate the alcoholic worker.

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and structural traps in fractured pre-Cambrian metamorphic rocks. About 50 wells in Rice County produce from fractured quartzite. Analogous to this Kansas oil production is some gas production in the Texas and Oklahoma panhandles from fractured granite.

The greatest depth to basement in Kansas may be in the Hugoton Embayment, with pre-Cambrian estimated at 9,500 feet.

In the eastern U. S., the Appalachian Geosyncline has an aggregate 55,000 feet of sediments measured on surface outcrops, with all ages, Cambrian through Pennsylvanian inclusive, being well represented. A highly diagnostic deep test was completed in 1955, penetrating all the Paleozoic section to basement. Hope Natural Gas Company 9634 Power Oil Company bottomed at 13,331 feet, 55 feet into pre-Cambrian gneiss.

This test, a dry hole, was located on the Burning Springs anticline in Wood County, West Virginia, about 25 miles southeast of Parkersburg. This structure has been oil-productive in shallow Carboniferous-age sands since 1860. No doubt the basement in others parts of the Appalachian Basin is deeper than it was found here. For instance, in the Leidy gas field, in north central Pennsylvania, the Devonian-age Oriskany sandstone is productive at 7500 feet, whereas the Oriskany was first found in the Hope Natural deep test at 4345 feet.

**In California,** deep, narrow basins and rugged topography paint a spectacular geologic picture, both on the surface and below. The deep oil basins, however, were formed in the Tertiary, and (depending on the individual basin) the pre-Tertiary is generally considered to be basement. On the other hand, gas production is found in some sands that may be of Cretaceous age in the Sacramento Valley.

What Cretaceous beds occur in Southern California are generally non-marine. In Jurassic time, the huge granodiorite intrusion occurred, which was later uplifted, and now forms the Sierra Navada. Thus, if Cretaceous cannot be considered as basement oil-wise, certainly Jurassic

rocks can. A rough estimate of the depth range of basement in the productive California basins would be from 8000 feet to 40,000 feet, but generalizations are hazardous. For instance, at Signal Hill, essentially vertical faults result in a horst, and schist is found at one part of the field as shallow as —10,000 feet, 4000 feet higher than basement found a short distance away.

**In Western Canada,** the Athabaska tar sands outcrop in northeast Alberta in Cretaceous beds above basement rocks. Mesozoic and Paleozoic sections thicken westward and southward to 15,000 feet in British Columbia and in the Williston Basin.

In both Eastern and Western Venezuela, Tertiary basins, underlain by Cretaceous sediments, may exceed 30,000 feet in vertical depth to basement.

At Campo Duran in northwestern Argentina, Yacimientos Petroliferos Fiscales has drilled as deep as 14,737 feet, and apparently the basement there is at least that deep.

In France, as in Germany and Holland, Jurassic sediments represent about the oldest oil target. One test in the Lacq field in the Aquitaine Basin of southern France bottomed below 16,000 feet, still in Jurassic.

The Paris Basin is much shallower, probably with less than 8000 feet of sedimentary section. The Rhine Graben, like an analogous oil province in the Red Sea-Suez area, would require a hypothetical well drilled in the deepest part of the trough that would cross a fault and thus drill out of the graben, before a definite depth to basement could be established.

**In the Sahara,** the depth to basement represents a very important problem. Interpretation of gravity and magnetic data is difficult because of apparent intra-basement anomalies not affecting the sedimentary section above. Another problem is a quartzite, possibly of Cambro-Ordovician age, which has proved impenetrable in some wells in Libya which were intended to reach pre-Cambrian. This would be of less importance were there not a possibility that this quartzite is correlative with the prolific oil-productive Cambro-Ordovician sandstone at Hassi-Messaoud and other important fields in Algeria.

At Hassi-Messaoud, one test reached basement at 12,600 feet, not much deeper than the producing sandstone. In Libya, basement depths vary greatly. Esso Standard (Libya) Inc. Haghe 1 in the western Fezzan found basement at about 3,400 feet, although originally projected to below 5,000. Elsewhere, production has been found below 10,000 feet in Libya.

Basement generally is not a factor in the Persian Gulf area and will not be until some future time when the present prolific shallow fields and those still to be found begin to play out and deeper drilling is required. The deepest test in Saudi Arabia went to 14,875 feet, and bottomed in (questionable) Permian; on Bahrain Island, the depth record is 11,985 feet in pre-Permian sediments. In Kuwait, the deepest hole reached 13,853 feet in Jurassic.

One diagnostic fact about the Persian Gulf is that salt plugs pushing up through the entire huge sedimentary section have brought big Cambrian trilobites up to the surface with the salt. Is there a thick section of


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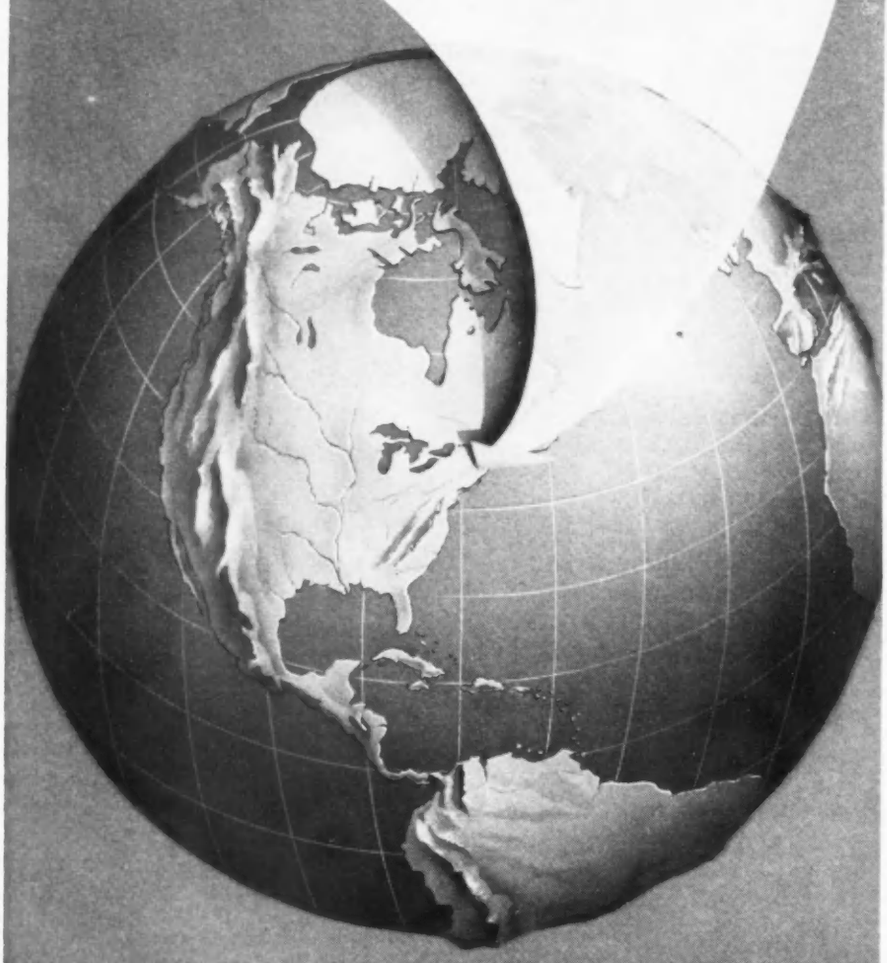

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older Paleozoic sediments below the "pre-Permian" at Bahrain and the possible Permian at 14,000 plus found in the extreme eastern part of the Rub al Khali drilled by Arabian American Oil Company? Only time —and deep drilling—will tell. At any rate, the basement is a long way down.

Dhofar-Cities Service Corporation's experience in drilling exploratory wells near the southern end of the Arabian Peninsula may shed some interesting light on the Cambrian problem there.

**In West Pakistan's** productive Potwar Plateau, in the northwestern Punjab, favorable marine deposition does not appear to predate the Eocene, and the deepest wells are projected to about 12,000 feet.

There may be as much as 25,000 feet of sediments Tertiary sediments lying against the mountain front north of current production on the Potwar Plateau.

**In India,** wells have been drilled as deep as about 14,000 feet in the Brahamaputra Valley of Upper Assam, the nation's main oil province. New deep production is from the Oligocene. If the underlying Eocene does not, for practical purposes, represent the basement here, the Shillong quartzites, which underlie the Cenomanian, certainly do. There may be as much as 50,000 feet of Tertiary sediments in Assam above the Shillong.

**In Burma,** the geologic habitat is similar to Assam, and oil production is from the Oligocene. The Cretaceous may also be prospective, but the deepest wells (located in the Irrawaddy River delta) have penetrated to about 13,100 feet and were still in Miocene at 12,000. The basement here is far, far out of sight of current economic drilling depth requirements.

### WHAT IS BASEMENT?

The term "basement," which to most geologists, means hard, crystalline igneous or metamorphic rocks that support the less durable sediments occurring in many parts of the earth's crust, has a more highly qualified meaning to others in the oil industry. When oil men say that a well has reached "basement," they mean that drilling deeper in search of oil would be futile as the known possi-

bilities for finding it by drilling deeper are nil. Usually, the strict geological meaning of "basement" and the driller's idea of when to quit may be equated, but there are a number of interesting exceptions.

When the cuttings contain granite, it is usually time to stop drilling, but in westernmost Venezuela, for instance, some production has been found in granite that had fracture porosity. The reservoirs have a common water level with adjoining permeable sedimentary beds that lap up onto the granitic intrusive. At least one well has been drilled as much as 1500 feet into granite in order to condemn beyond question the possibilities. And in other areas, it may be a good idea to drill 50 or more feet below the top of the granite to be sure that an intrusive offshoot, such as a pegmatite dike, has not been mistaken for the main intrusive body.

Schist, a common metamorphic rock, almost always is a reliable hole stopper, but the prudent oil man would, at least in one area, be careful to see that the rock was a true, fully metamorphosed schist, and not a partly altered schistose sedimentary, such as might be the case with part of the puzzling "Ouachita facies" of south and central Texas.

**The finding of pre-Cambrian** sediments represents a good time to stop, too, as virtually no marine life existed prior to the Cambrian age, and oil apparently has an organic source. However, unusual structural relationships require a qualification here, too.

In parts of Montana, Idaho and British Colombia, there is a series of only slightly altered pre-Cambrian limestones, sandstones and shales, containing some very archaic fossils, called the Beltian System, comprising 35,000 feet of aggregate thickness. In Glacier National Park, excellent exposures clearly show the base of this ancient series lying on younger (Cretaceous) sediments. The great Lewis overthrust reversed the normal position of the beds.

However, some experts will not say that a wildcatter will not spud into pre-Cambrian Beltian beds some day and find oil in younger sediments below the thrust plane. And the idea is even less preposterous when one considers that the strong tectonic forces that moved the huge mass of Beltian rocks may well have caused folding in the younger beds and have given rise to structures that might now bear oil.

Salt, both in the form of domes, deep-seated or piercement, and thick flat-lying sedimentary beds, presents both local and regional problems as to the depth, for practical purposes, of the "basement." In West Germany, big regional salt ridges provide a depth limit for oil, once a well has been drilled into enough salt to assure sufficient penetration of the major salt body.

But here again, the problem is complicated. How much hole is enough to determine that a body of salt is the main plug and not just an overhang? Shell Oil Company, guided by precise geological and geophysical work, drilled through a 10,000-foot salt overhang in south Louisiana several years ago to complete an oil well in a Tertiary sandstone below 13,000 feet.

**In northern Holland,** there is almost 3,000 feet of Permian salt strata above 4,500 feet. Whether there are any prospective Paleozoic sediments below all that corrosive salt represents, in a sense, a practical basement


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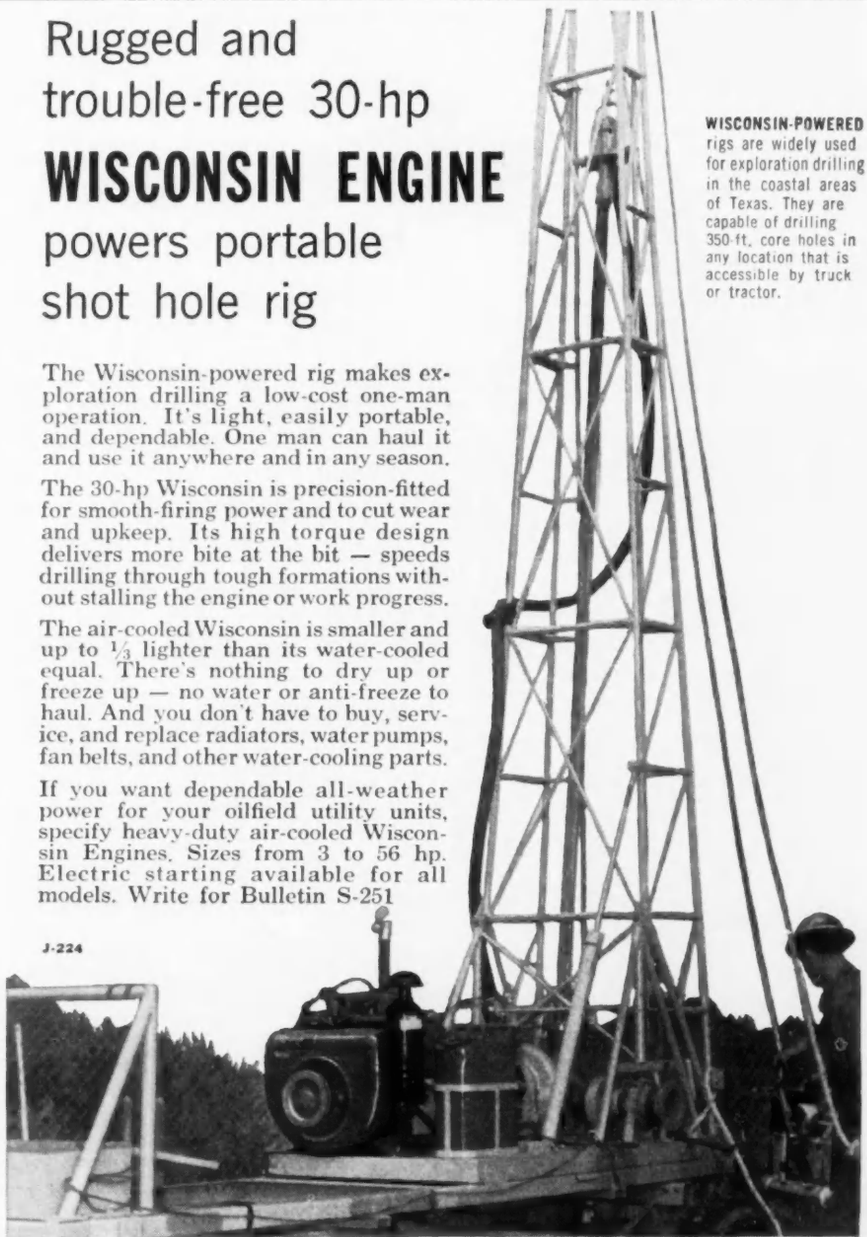

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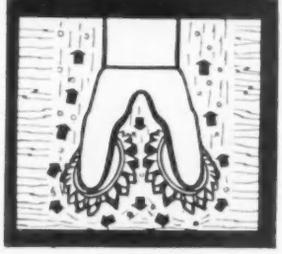

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problem involving economics at least as much as geology.

The encountering of volcanic rocks of any kind gives a driller pause, but mere volcanics cannot be unqualifiedly interpreted as basement. In Indonesia, volcanics—and pre-Tertiary volcanics at that—are without exception regarded as basement. All production is from Tertiary beds above 8000 feet, and, in Sumatra, usually above 5000 feet. Below the Tertiary, volcanic rocks and fast-rising bottom-hole temperatures condemn both the chance of finding oil and of making much more hole even if there were anything other than oil to be found by drilling deeper. But this is not too bad a blow to Indonesia's oil future, since the great majority of the world's big oil fields are found above 8,000 feet anyhow.

But in other parts of the world, particularly in Mexico, where localized intrusives, both in the form of dikes and sills, have invaded the prospective sedimentary columns, they have not succeeded in boiling away all the oil.

One of the most prolific oil-forming ages in many parts of the world was the Miocene, also one of the most violent of geologic epochs, with widespread volcanism.

**In Cuba,** some oil occurs in sporadic fashion in small and moderate quantities in serpentine, part of a big ultrabasic (peridotite) complex that has weathered unevenly into its metamorphic equivalent. How the oil got there, and how more of it can be scientifically found, is a problem that awaits solution.

Harry Wassall has an interesting theory to explain this. Briefly stated, it called for northward overthrusting of ultrabasic rocks onto Cretaceous limestones followed by weathering of the ultrabasics into serpentine, uplift, faulting, and migration of oil into the serpentine from formations below.

Suffice to say that exactly where the basement is in many parts is an unsolved problem, not entirely explained by the fact that in many cases wells simply have not been drilled deep enough to find basement.


ACKNOWLEDGMENT

The writer wishes to thank Dr. Peter T. Flawn, Bureau of Economic Geology, The University of Texas, Austin, for his help in preparing this article. The work of many other geologists provided additional data. A basement map of North America is to be published in the future jointly by The American Association of Petroleum Geologists and the United States Geological Survey.

# Pumping 12,000 bwpd

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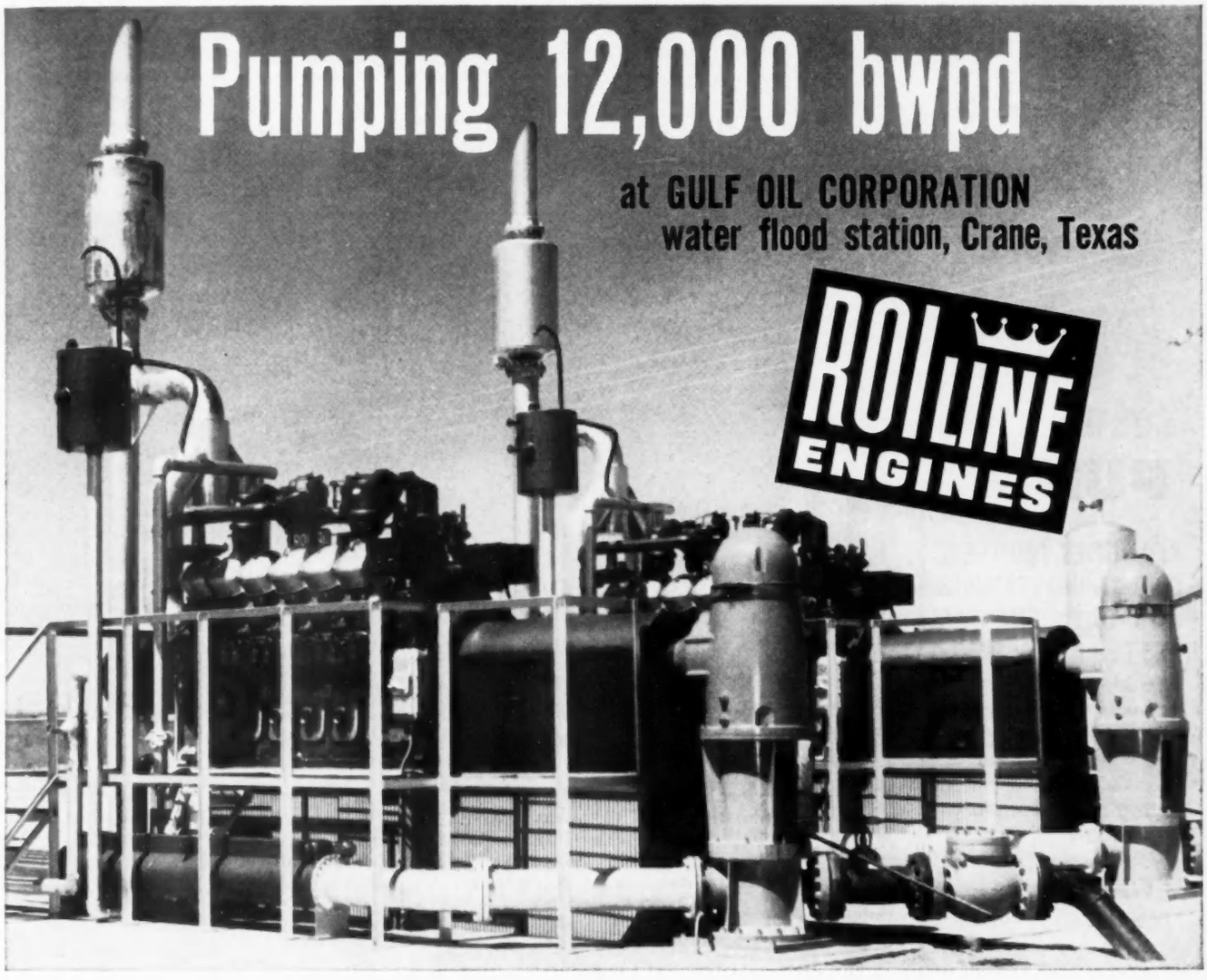


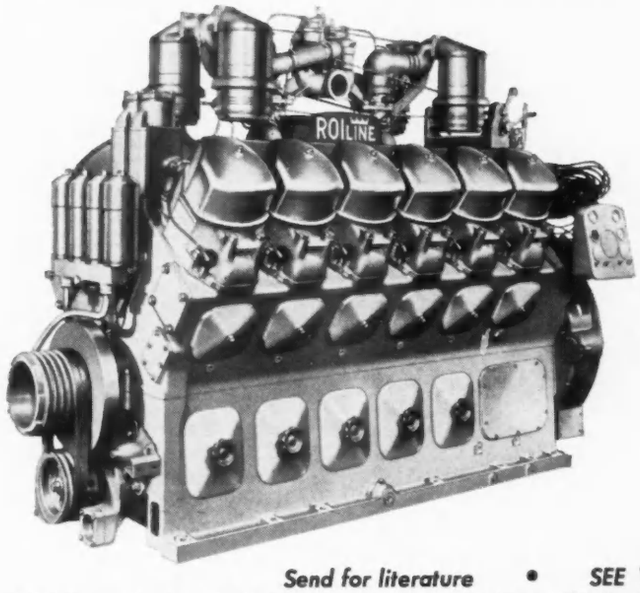


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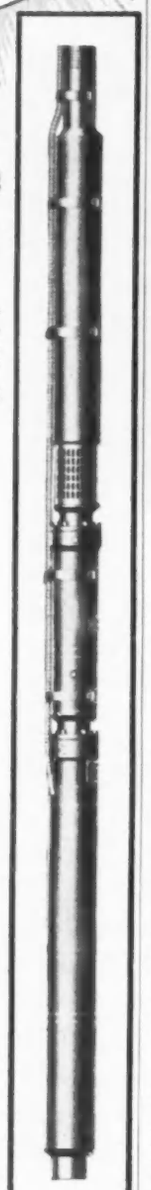

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# Your industry at work

## A monthly roundup of items of interest about people, companies and associations

### *A Student-to-Vice President Talk*

**Gaylord A. Virden (left), one of 13 university students who participated in Mobil International Oil Company's Mobil Summer Abroad program, discusses his project with E. C. Cram, Mobil International regional vice president. The program enables outstanding students to consider careers in international work while conducting special summer study projects for the company.**

### Texas-New Mexico Interests Purchased By Kern County Land

Kern County Land Company has announced the purchase of interests in leases in four producing oil fields in western Texas and Southeastern New Mexico for some $2.75 million, part of which was defrayed by an oil payment. Thirty wells are on the properties, producing a light, sweet oil that is in high demand.

The purchase includes Texas properties in the West World field in Crockett County, the Mt. Susan South field in Tom Green County, the Grice field in Loving County, and the El Mar field in Loving County, Texas, and Lea County, New Mexico. The oil leases in these fields were purchased from the Ecland Oil Participation Corp., New York, and Hill & Meeker and Brown & Roper, both firms of Midland, Texas.

Operation of the fields is being directed by Ronald Yancey, the company's district superintendent in charge of operating oil properties. Yancey was moved to headquarters in Midland from KCL's Bakersfield, Calif., offices.

### West Texas $CO_2$ Company Is New Jointly Owned Firm

The formation of the West Texas $CO_2$ Company has been announced by James A. Bentley, president of Oil Recovery Corporation and Walter H. Helmerich, president of Helmerich & Payne, Inc. Both companies will share equally in the ownership of the new company.

The West Texas $CO_2$ Company's first plant is to be located near Fort Stockton, Texas, and will produce liquid carbon dioxide for use in secondary oil recovery projects utilizing the Orco process.

The patented Orco process, which is wholly owned by Oil Recovery Corporation, is basically the treatment of a crude oil reservoir with controlled amounts and concentrations of carbon dioxide ($CO_2$) or solutions of carbon dioxide. The Orco process will recover more secondary oil faster, with more profit, than is possible by conventional water flooding.

Edward Edmunds, Jr., of Albuquerque, N. M., has been named General Manager of West Texas $CO_2$ Company, with W. R. Hay as plant superintendent, Fort Stockton, Texas.

### U.S. Oil Executives Tour Russia's Oil Industry

Eight American oil company executives visited Russia recently under the East-West exchange program sponsored by the Department of State.

The American oil men spent the month of August in a tour of Russian oil fields, refineries and research instal-

lations over a wide area, including offshore drilling in the Caspian Sea.

The American Petroleum Institute helped with the arrangements, at the State Department's request, and will aid the department in arranging a reciprocal trip later this year for a Russian group.

Members of the American party included W. W. Keeler, executive vice president of the Phillips Petroleum Company, Bartlesville, Okla.; Ira H. Cram, New York, senior vice president, Continental Oil Co.; George S. Dunham, New York, director, Socony Mobil Oil Co.; W. M. Elias, Tulsa, vice president, Pan American Petroleum Corp.; George F. Getty, II, Los Angeles, president, Tidewater Oil Co.; George T. Piercy, New York, head of the Petroleum Economics Department, Standard Oil Co. (N. J.); Neal J. Smith, Houston, vice president, Chevron Oil Co., and Dr. Noyes D. Smith, Jr., Houston, vice president, Shell Development Co. Alex Gakner and Robert Ebel of the Department of the Interior also will be in the party.

## Texas School Teachers Complete Petroleum Workshop

Fifty-one school teachers from 15 Texas cities have completed the third annual Petroleum Workshop on the campus of the University of Houston.

**Texas teachers, totaling 51, busy studying at third annual Petroleum Workshop which was held recently on the University of Houston campus.**

Each participant earned three hours of postgraduate credit for the course, sponsored each year by the Texas Mid-Continent Oil and Gas Association, the University, and some 50 oil industry firms. The companies provided funds for the program in the form of individual scholarships.

During the three-week workshop, the teachers-turned-students heard top petroleum experts from 34 oil, service and supply firms. Featured speakers were Railroad Commissioner William J. Murray and B. S. Sines, executive vice president of the Texas and New Orleans Railroad.

The group also visited four industry installations: the Diamond Alkali Company plant, Hughes Tool Company, Humble Oil & Refining Company research center and the Shell Oil Company refinery.

Objective of the course is to aid secondary school teachers in acquiring an understanding of petroleum's place in the nation's economy and to provide them with information which can be used to strengthen their classroom curriculum.


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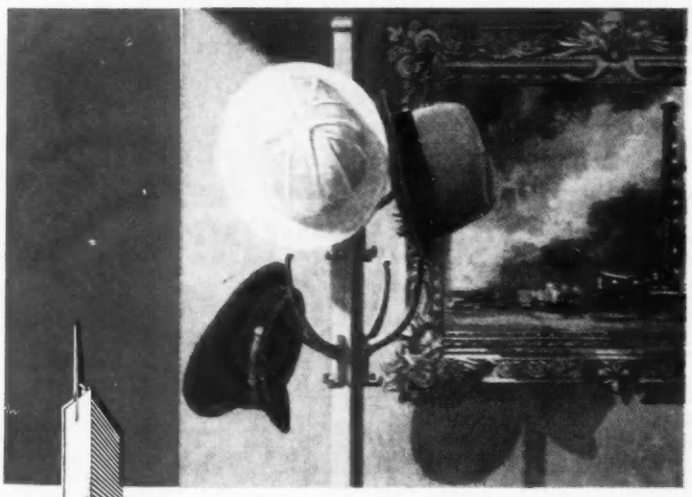

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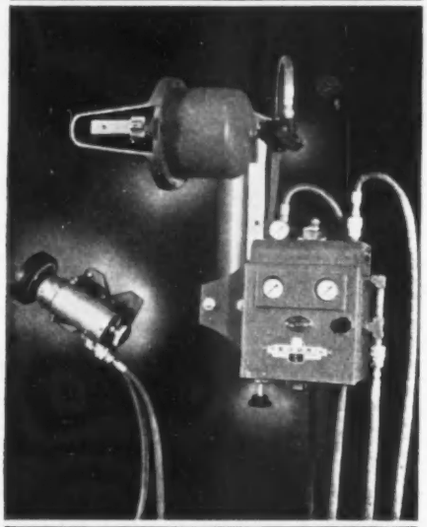

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# Men in the industry

J. E. Swearingen F. O. Pryor

## Standard Executives

**Frank O. Pryor (right), retired chief executive officer of Standard Oil Company (Indiana), is shown with John E. Swearingen who has been appointed to succeed Pryor in that position.**

**Keith Doig** has been named chief mechanical engineer in **Shell Oil Company's** Houston area Production Department. He succeeds **John M. Payne** who transferred to Shell's Denver area.

**Joseph E. Morero,** in charge of geology and geophysics, and **Al Cashman,** in charge of land and leases, have been promoted to senior vice presidents of **Skelly Oil Company.**

**Park Ogden,** formerly district geologist with Buffalo Oil is now assistant division geologist for **Continental Oil Company** in New Orleans. **Ray Heggland** has been transferred and promoted to offshore district geologist in Continental's Houston office. **Bob Gannaway** has transferred to the firm's Shreveport, La., District.

**Norm Tabor** has joined **El Paso Natural Gas Company** in San Antonio, Texas. He was formerly with The California Company.

**Earle B. Knott** has been promoted to district exploration superintendent at Corpus Christi, Texas, for **Tennessee Gas and Oil Company,** the domestic and Canadian Exploration and Production Division of **Tennessee Gas Transmission Company.**

**Joseph W. Morris** has become general counsel for **Amerada Petroleum Corporation** of Tulsa, after resigning from the legal staff of Shell Oil Company in New York.

**Jack C. Hardy, Jr.,** has been named assistant general attorney for **Sun Oil Company's** Gulf Coast Production Division at Beaumont, Texas. Hardy succeeds **Charles F. Heidrick** who has been named general attorney for Sun's Southwest Division at Dallas.

**LeRoy W. Holm** has been promoted to the position of supervisor of the secondary recovery section of the Production Engineering Research Division at the **Pure Oil Company's Research Center.**

**Arthur J. Tschoepe,** recently resigned from Cosden Petroleum Corporation will open an office as an independent geologist in the Wilson Building at Corpus Christi, Texas.

**Jack R. Mills,** Los Angeles petroleum executive, has joined the Oil and Gas Division of **Citizens National Bank.**

**Frederic B. (Fritz) Loomis** has been appointed chief geologist of **Clark Oil & Refining Corporation's** Denver Exploration and Production Division.

**John M. Shea, Jr.,** and **Ralph E. Damp,** have been elected to the board of directors and as corporate vice presidents of **American Petrofina, Inc.**


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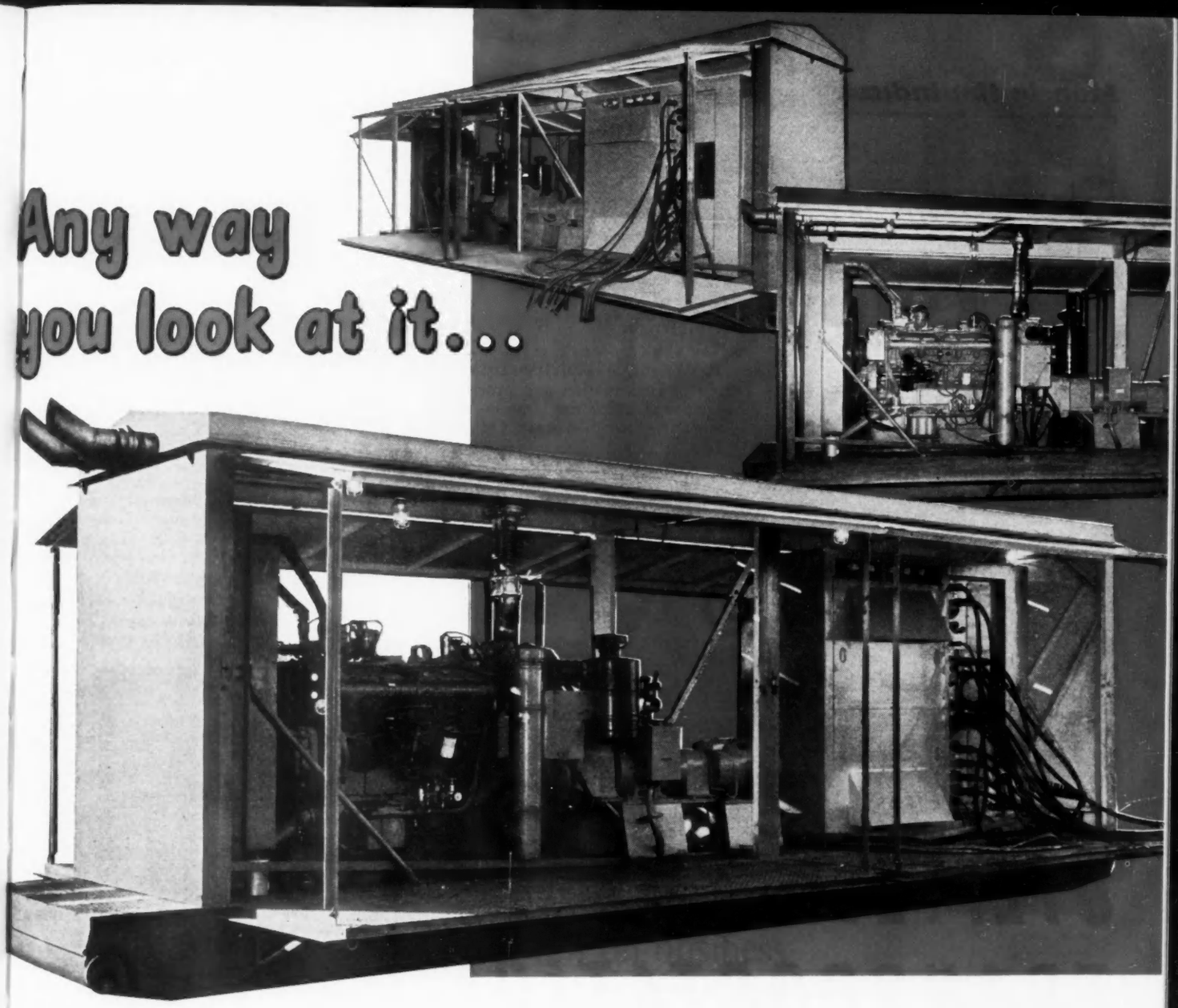


# CUMMINS VT-12 AND GE 602 ENGINE-GENERATOR COMBINATION ...A NATURAL FOR YOUR RIG POWER

**Check the Cummins VT-12 TURBODIESEL Engine and GE 602 Generator combination from any angle and you'll see why more and more companies are specifying this unit to power their electric drilling equipment.**

**Check it for drilling efficiency and speed. The Cummins VT-12 is "power-matched" to the General Electric 602 generator for more efficient electric rig drive. Electric powered drilling equipment can (1) virtually eliminate drillstem damage, (2) provide high accelerating torque for faster round trips, and (3) furnish rugged, dependable power for mud pump service.**

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**Check all the advantages of this modern power package. Call your Mid-Continent representative for full details on how the Cummins VT-12 and GE 602 engine-generator combination can increase your drilling profits.**

CU1-0

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## *Men in the industry*

**Ralph W. Collins** has been appointed vice president in charge of the Production Department of **Midwest Oil Corporation.**

**D. C. Wixson** has been named administrative vice president for the **Sunray Mid-Continent Oil Company's** family of companies.

**King-Stevenson Oil Company, Inc.,** have moved their offices from 1825, First National Bank Building, to **Suite 2200, First National Bank Building, Denver.**

F. F. Wright

H. C. Calhoun

**F. F. Wright,** executive assistant in charge of conservation and proration in the general office Exploration Department, Tulsa, for **Sinclair Oil & Gas Company,** has been named assistant manager of West Texas Division in Midland. **Henry C. Calhoun,** executive assistant to **L. L. Ware,** vice president and exploration coordinator, was placed in charge of conservation and proration, succeeding Wright. Wright succeeds **O. G. Simpson** who has transferred to New Orleans as assistant manager of the Southeastern Division for Sinclair.

**Wilbur R. Lilly** and **Harold R. Mayer,** both former Gulf Oil Corporation engineers in the Jackson, Miss., District office, have opened an office in the Petroleum Building in Jackson, **Lilly and Mayer, Consulting Petroleum Engineers.** The new firm will specialize in oil and gas reserves, property evaluation, drilling and completion, production and State Oil and Gas Board hearings.

**Merwin H. Soyster,** formerly district engineer for the **United States Geological Survey** in Oklahoma City, is now in charge of the new U.S. Geological Survey office in Anchorage, Alaska.

**J. W. McDonald** has been named exploration manager of **Shell Oil Company's** Eastern Division, headquartered in Pittsburgh. McDonald succeeds **P. W. Fairchild** who is now on special assignment in the company's head office in New York. McDonald will direct Shell's exploration activities in the general area lying between the Mississippi River and the Appalachian Mountains and extending from Tennessee, northward.

J. W. McDonald

**Stevenson and Associates, Inc.,** have recently moved to new offices in the **First National Bank Building, Suite 1208, Minneapolis 2, Minn.**

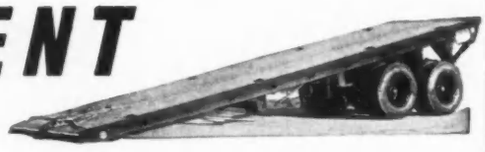
**O. Wayne Crisman** has been promoted to general manager of the Production Division in Dallas for **Delhi-Taylor Oil Corporation.** Also, **J. H. Doughman** was promoted to manager of the Production Department. **R. S. Wansbrough** was named manager of the Production Engineering Department succeeding Doughman. **K. P. Kerr** is the manager of the newly-created Production Technical Service Department. **W. S. McCreedy,** is assistant to Kerr. **Clinton H. Britsch** was promoted from district engineering to district superintendent in McAllen, Texas, and **G. T. Higginbotham** succeeds Britsch as McAllen district engineer.

**George His** has resigned his position as geologist with the Standard Oil Company of Texas, and has joined **Edman R. Zink** in forming the firm of **Zink & His, Petroleum Geologists.** Offices of the new firm are located in the **Petroleum Center,** San Antonio, Texas.

**OILFIELD TRUCK AND FLOAT**

Thornycroft Sandmaster 252" wheel base Oilfield Truck. Hands-England full Oilfield Body. 60,000 lb. winch, heavy duty gin poles, winch operated gin pole risers and folding SAE king pin.
Hands-England 75,000 lb. capacity, tandem axle Oilfield Float 30' 0" long and 9' 6" wide, folding support legs and inverted 36" fifth wheel
Truck and Float on Michelin 18.00 x 25. Sahara "X" sand tires.

# OILFIELD TRANSPORTATION EQUIPMENT



**OILFIELD FLOAT**

Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30' 0" long and 8' 6" wide, folding support legs and inverted 36" fifth wheel.
Float on 11.00 x 20 — 14-ply tires.

**OILFIELD TRUCK AND FLOAT**

Scammel Constructor 261" wheel base Oilfield Truck.
Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30' 0" long and 9' 6" wide, folding support legs and inverted 36" fifth wheel.
Truck and Float on 14.00 x 20—18-ply tires.

**OILFIELD FLOAT**

Hands-England 25,000 lb. capacity single axle Oilfield Float 24' 0" long and 8' 0" wide, folding support legs and SAE king pin 11.00 x 20—12-ply tires. Steel stake sides.

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B.M.I.

## Men in the industry

**Dr. Glenn S. Visher** has joined **Sinclair Research Laboratories, Inc.,** as a research geologist at the company's Tulsa laboratory.

**Lloyd R. Hale** has been appointed safety supervisor of the Production and Exploration Department for **Lion Oil Division of Monsanto Chemical Company.** Hale will headquarter in Houston.

**James K. Wootan** has been named vice president in charge of exploration and **Paul E. Ludman** was named a vice president of **Signal Oil and Gas Company.**

**O. F. Van Beveren** has been elected president of **American Overseas Petroleum Limited** (**Amoseas**). The company is a member of the **California, Texas Oil Corporation** (**Caltex**) group of oil companies which operate in the Eastern Hemisphere. Van Beveren succeeds the retiring **G. M. Cunningham.**

**J. E. Trigg,** partner in **Trigg Drilling Company,** Oklahoma City, has been elected a director of **Tekoil Corporation.** Tekoil has executive offices in Dallas, operations offices in Oklahoma City and regional offices in Midland, Texas. Trigg is a veteran oil driller, having started in business in 1919. Prior to that he was associated with the First National Bank of Burkburnett, Texas.

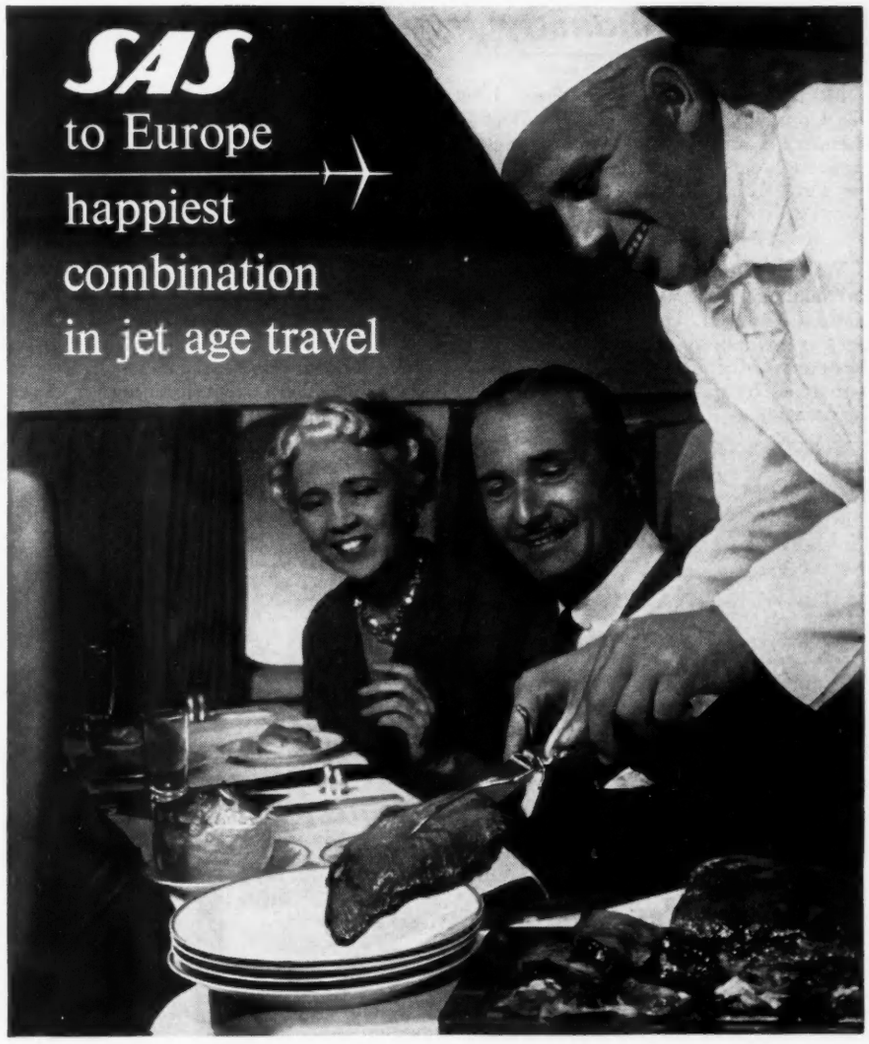
J. E. Trigg

**John H. Weems** has joined the geological staff of **Associated Oil & Gas Company,** Houston. Weems has been with Sohio Petroleum Company.

**Maynard M. Stephens** is now devoting his full time to his private consulting practice **Maynard M. Stephens Company,** Wichita Falls, Texas. Stephens has been Dean of the School of Petroleum and Physical Sciences of Midwestern University in Wichita Falls.

**John H. Watkins** has been promoted to district office supervisor in the **Tennessee Gas and Oil Company's** Wichita Falls, Texas, production office. Tennessee Gas and Oil is a Division of **Tennessee Gas Transmission Company.** Watkins succeeds **E. L. Patterson** who was transferred to Lafayette, La.

**R. Russell Turner** has been named district superintendent at **Pan American Petroleum Corporation's** Alberta District in Edmonton, succeeding **W. M. Jones** who has been transferred to the Rocky Mountain Division as district superintendent of the Casper, Wyo., district.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## Men in the industry

**J. M. (Jim) Henagan** has joined **Lion Oil Company Division of Monsanto Chemical Company** as a senior petroleum engineer and has been assigned to the petroleum engineering staff at Houston.

**J. Wayne Hinds** has been named general manager of **Vigor Oil Company, Limited,** Oshawa, Ont. Vigor Oil Company is owned by **Murphy-Canada Oil Company.** Murphy-Canada is a wholly-owned subsidiary of the **Murphy Corporation.**

J. O. Bower

F. L. LeRoy

**John O. Bower** has been elected president and chief executive officer of **Colsag Corporation,** parent company of Colombian oil interests, jointly owned by **Socony Mobil Oil Company, Inc.,** and **Texaco Inc.** Also, **Frank L. LeRoy** has been elected vice president and general manager of Colsag's operating subsidiaries, **Colombian Petroleum Company** and **South American Gulf Oil Company.** LeRoy succeeds **Max E. Crawford** who has returned to Texaco Inc., and assigned to Caracas, Venezuela, as manager of the Venezuelan producing division of its subsidiary, **Texas Petroleum Company.** Bowers will headquarter in New York, and LeRoy will make his offices in Bogata, Colombia.

**Bill Guinn** has been added to the division geological staff of **Continental Oil Company** in Casper, Wyo.

**William V. Wade,** consulting geologist at Abilene, Texas, has moved his office to McCook, Neb., and will specialize in the Cambridge Arch play of Nebraska and Kansas.

**Joseph F. Mueller** has joined **Keplinger and Wanenmacher, Petroleum Engineers,** Tulsa. His duties will include oil and gas reserve estimates and special reservoir studies.

**Harry A. Trueblood, Jr., Saul A. Levine** and **Theodor F. Rittenberg,** all of Denver; **Carl J. Odegard,** Huron, S. D.; **James D. Landauer, Daniel T. O'Shea** and **Henry A. Wilmerding,** all of New York, and **John E. Price,** Ft. Meyers, Fla., have been re-elected directors of **Consolidated Oil & Gas, Inc.** Also, Trueblood was elected president; Levine, executive vice president and secretary; **J. B. Ladd** was elected vice president and manager of operations; Rittenberg, treasurer and assistant secretary; **E. O. Cummings** was elected assistant treasurer, and **C. J. Cooper** was elected assistant secretary.

**Spence T. Taylor** has been named president of **Mobil Oil de Venezuela,** affiliate of **Mobil International Oil Company.** Taylor succeeds **Dr. James A. Tong** who will continue in an advisory capacity pending his retirement January 1.

**Cecil M. Keller,** Tulsa, formerly with Tidewater Oil Company, has recently formed **Cecil M. Keller and Company,** to deal independently in oil properties and to specialize in contract unitization service.

**W. A. (Bob) Roberts** has been named superintendent of the Production Department's Central Division for **Phillips Petroleum Company.** Roberts will have offices in the Braniff Building, Oklahoma City. Roberts succeeds **W. M. Schul,** retired. **E. E. Clark,** succeeds Roberts as superintendent of the California District, and **L. H. Hoelscher,** district engineer in California, becomes assistant superintendent of the California District. **M. L. McKee,** area engineer located in Bartlesville offices of the Production Department, becomes assistant superintendent of the North Burbank Unit, Osage County, Oklahoma, replacing Clark.


# MODERN ENGINEERED GAS LIFT VALVES

*Guaranteed Low Cost Maintenance*

A Harold Brown Gas Lift Valve is available for every type Gas Lift Installation.

**H-B Gas Lift Valve Features:**

- **Large Dome Capacity**
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- **Bellows Support Rings prevent reduction in convolution radius**
- **Replaceable stem and seats**

**Normally Closed Check Valves**

**Three interchangeable types:**

- **Magnetic cage check valve**
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*These Superior Features and the Long Wear of H-B Check Valves Make This Possible!*

GUARANTEED EXCHANGE POLICY FOR STANDARD VALVES

1 year in hole—full warranty against mechanical defect.
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2 to 3 years in hole—Exchange $35.00
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Slight additional cost for retrievable valves. Also five dollars additional cost outside mid-continent areas.

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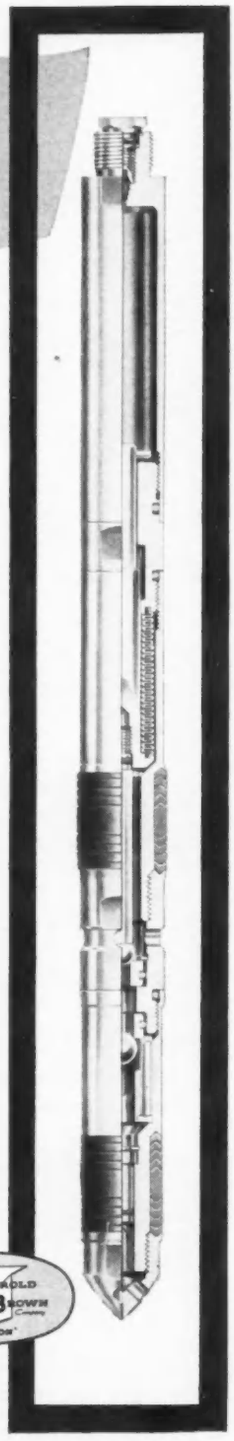

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# Irons Give Pumps and Valves of Valuable Properties

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They combine the strength and toughness of ductile iron with the corrosion resistance of Ni-Resist.

Each type combines engineering properties which improve the performance and extend the service life of pumps, valves, and other oilfield equipment:

- **Strength**—Ni-Resist ductile irons provide tensile strengths of 55,000 to 65,000 psi, yield strengths of 30,000 to 40,000 psi.
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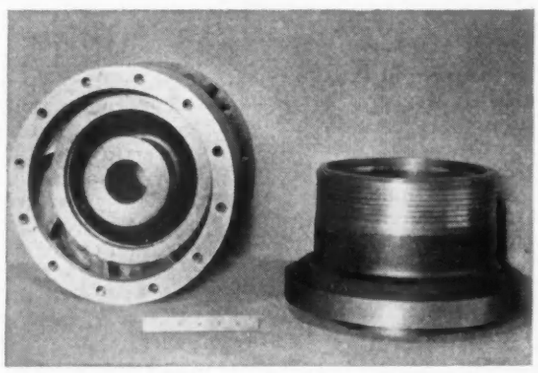

**CAST TO LAST**—Pump at left is being installed in an Oklahoma well to move large quantities of salt water in a secondary recovery operation. Both the diffuser and pump head (above) are castings made of corrosion-resisting Ni-Resist Ductile Iron.

- **Corrosion Resistance**—Ni-Resist ductile irons safely handle such corrosives as sour crudes, mineral acids in crude, salt water, and oil-filled brines.
- **Wear Resistance**—Ni-Resist ductile irons can be mated to many engineering materials, where they have excellent resistance to wear and galling over a wide range of temperatures—especially under corrosive conditions.
- **Erosion Resistance**—Ni-Resist ductile irons give outstanding performances in high-velocity liquids. Their high strength and resistance to cavitation-erosion mean long service for pump parts.
- **Machinability**—Ni-Resist ductile irons machine as well as common pressure-type gray irons.

**Other features, too.** We've given only some of the highlights. You can get more facts about this versatile new family of hard-working, long-lasting metals in our...

**Free Booklet,** "Engineering Properties of Ni-Resist Ductile Irons." Here—complete with photos, tables and graphs—you'll have all the information you need to decide how and where Ni-Resist ductile irons can help you. To have all the facts on hand, just write for your copy.

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*"Excellent . . . enriches the literature of world petroleum history . . ."* DR. C. P. DE LA COVA, Venezuelan Petroleum Minister to the U. S.

**THE FIRST BIG OIL HUNT VENEZUELA, 1911-1916**

by RALPH ARNOLD, GEORGE A. MACREADY and THOMAS W. BARRINGTON

Now, made public for the first time—the complete story behind the famous Arnold Survey—the greatest private geologic survey for oil the world had ever known . . . resulting in the discovery of the majority of today's producing fields in Venezuela.

This book covers the fascinating "hunt" in all its aspects—the companies involved, the people, the results — all described in vivid detail, bringing to life a search of vast historic significance.

It all began with a recommendation from Herbert Hoover, and soon Dr. Arnold, noted geologist and petroleum engineer, was deep in the Venezuelan jungle, involved in explorations which were to bring him world-wide acclaim.

*"The First Big Oil Hunt"* is a book of solid fact that will give you valuable insights into the handling of men and equipment. It is important reading for everyone associated with the oil industry—operators, drillers, manufacturers or suppliers. *Just published.* $10.00. Over 300 photographs. 353 pages. 7" x 10½". Money refunded in 10 days if not fully satisfied. *Get a copy from your local bookstore, or postpaid from:*

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# Associations

***Guests of Los Angeles NOMADS***

**International guests at a recent meeting of the Los Angeles Chapter of NOMADS were, front row, left to right, Stan Nelson of D & E from Iraq; E. E. Lay of Qatar Petroleum Company from Qatar; George A. Waters of Qatar Petroleum from Arabia, and Paul Hughes of Ralph M. Parsons from Ethiopia. Back row, left to right, Everett Forte of Esso Standard from Libya; J. W. Killingsworth of Iraq Petroleum Company from Kirkuk; Mel Cooper of Volco, Inc., from Colombia, and R. B. Hearns of Cal Tex from Sumatra.**

## API's Southern District Elects Maxwell Chairman

Byron Maxwell, United Fuel Gas Co., Charleston, W. Va., has been elected chairman of the Eastern District of the American Petroleum Institute's Division of Production. Maxwell succeeds Wendell S. Moore, Columbian Carbon Co., Charleston, who was named chairman of the District's Advisory Committee. The district covers Michigan, Illinois, Indiana, Kentucky, Ohio, New York, Pennsylvania, and West Virginia.

Named vice chairmen at the three-day meeting were: H. J. Magner, Delta Drilling Co., Pittsburgh; W. C. Best, Gulf Oil Corp., Evansville, Ind.; W. F. Eiting, Humble Oil & Refining Co., Mattoon, Ill.; H. T. Heuple, Manufacturers Light and Heat Co., Pittsburgh; J. Robert Hornor, Delaware Gas Co., Clarksburg, W. Va.; Melvin Sauter, Sun Oil Co., Mt. Pleasant, Mich.; John Kime, Preston Oil Co., Columbus, Ohio; Nace Mefford, Ashland Oil & Refining Co., Ashland, Ky.; L. T. Evans, East Ohio Gas Co.; North Canton, Ohio; Fred Moran, independent, Owensboro, N. Y., and Earl Linn, Hiawatha Oil & Gas Co., Pittsburgh. D. C. Hubbard, Ohio Fuel Gas Co., of Columbus, was named secretary-treasurer.

## L. E. Elkins Nominated President-Elect of AIME

Lloyd E. Elkins, production research director of Pan American Petroleum Corporation, has been nominated president-elect of the American Institute of Mining, Metallurgical and Petroleum Engineers. The new president-elect will take office as president in 1962. Elkins has served the AIME in past years as a member of the board of directors and vice president.

## Fundamentals of Geology Planned at Texas A & M

The Department of Geology and Geophysics at Texas A. & M., College Station, Texas, will offer a special course on "Fundamentals of Geology" for the petroleum industry from November 28 through December 22.

The course is designed for engineers, physicists, chemists, mathematicians, and lawyers as well as for supervisory personnel who have had no formal training in geology but need a basic understanding of the geologic processes. The general plan and outline for the course has been patterned after a special course which A & M has given for the past four years for the engineers of a major oil company.

The course will include a total of 54 hours of lecture and 75 hours of laboratory work during the four-week period. The registration fee is $250 and the course carries no college credit. Classes will be limited to approximately 25 men and admission will be based entirely upon the dates that applications are received.

## B. H. Lord Succeeds James E. Moss in API

B. H. Lord, Jr., has been appointed to succeed James E. Moss as director of the Division of Transportation of the American Petroleum Institute. Moss re-

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# Rector makes the hook-up that is Sealed with Steel throughout

Rector wellhead equipment is designed to insure a leak-proof seal at all connections. Compare Rector's metal-to-metal seal features with any equipment on the market using resilient packing between casing and tubing strings. The Rector principle of reinforcing temporary organic packing with a permanent ring of steel insures a positive leak-proof completion every time. Rector's built-in welding ring coupled with an API ring gasket is easy to install, immune to corrosion inhibitors, will not flow under high pressure or temperature, will not freeze or contract under low temperature, will not burn out, and never requires maintenance or replacement.

There are no weak links in your completions, when you specify Rector equipment at your favorite supply store, or from your Rector representative.

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tired August 1, but will continue to serve the petroleum industry as a special consultant on President Frank M. Porter's staff.

Lord, who joined the API staff in 1946, has been the division's associate director during the last year.

## Babb New President Of Jackson Geophysical Society

John Babb, Delta Exploration Company, has been elected president of the Jackson, Miss., Geophysical Society. Other new officers are: Tom Tillman, Sun Oil Company, vice president, and Jim Watson, Humble Oil & Refining Company, Carter Division, secretary-treasurer.

## Ben H. Parker Installed As New President of AAPG

Ben H. Parker, president of Frontier Oil Company, Denver, was installed as the new president of the American Association of Petroleum Geologists at the joint session of the AAPG and Society of Economic Paleontologists and Mineralogists (SEPM), held recently in Atlantic City, N. J. Parker succeeds Lewis A. Weeks, consulting geologist, Westport, Conn., who will continue on the Executive Committee of the Society as past-president for the coming year.

Other new officers for 1960-61 are: Frank B. Conselman, consulting geologist, Abilene, Texas, incoming vice president and George V. Cohee, U. S. Geological Survey, Washington, D. C., secretary-treasurer. Grover E. Murray, professor of geology at Louisiana State University, Baton Rouge, La., was re-elected editor of the Society.

J. C. Hollister

J. P. Woods

F. A. Hale

R. C. Kendall

## Dr. J. P. Woods Elected 1961 President of SEG

Dr. J. P. Woods, director of the geophysical laboratory of The Atlantic Refining Company, Dallas, has been elected president of the Society of Exploration Geophysicists. He succeeds current SEG President T. O. Hall, president of General Geophysical Company.

Professor John C. Hollister, head of the department of geophysical engineering, Colorado School of Mines, Golden, Colo., was elected first vice president at the society's annual election. Robert C. Kendall, area geophysicist of Shell Oil Company, Denver, will be vice president, and Francis A. Hale, chief geophysicist of The California Standard Company, Calgary, Alta., was elected secretary-treasurer.

The new officers will take over at the society's thirtieth annual international meeting which will be held in Galveston, Texas, November 7-10.

## Tindell Named Chairman of Southwestern Geologists

W. N. Tindell, Mayfair Minerals, Inc., was recently elected chairman of the Southwestern Federation of Geological Societies for 1960. Other new officers include Dona A. Zimmerman, Sun Oil Company, vice chairman; W. G. McCampbell, Jr., Humble Oil & Refining Company, secretary, and Richard Kent Waddell, Coastal States Gas Producing Company, treasurer.


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SWAGED NIPPLES and BULL PLUGS

Safety . . . craftsmanship . . . durability . . . precision . . . yes, these elements are important in Swaged Nipples and Bull Plugs. And, these are the elements found in *all* W. C. Norris fittings — elements proven by the experience of our customers.

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**HALLIBURTON SUPER SEAL FLOAT SHOE**

- Special formula concrete guide nose helps steer casing string away from downhole ledges.
- Super Seal Valve helps reduce weight on derrick by causing well fluid to partially support the load as the casing is lowered.
- After cement placement, Super Seal Valve with rubber sealing element closes to help prevent reverse circulation of cement.
- Specially designed Plug Seat Insert is made of molded plastic to help prevent internal damage when bottom cementing plug lands in tool.
- All internal parts are of drillable material.
- Identical features available in Super Seal Float Collars.

**HALLIBURTON AUTOMATIC FILL-UP FLOATING EQUIPMENT**

- Saves running-in time of casing by eliminating frequent stops for filling pipe. Fill-up unit holds Super Seal Valve open to allow well fluid to enter pipe through calculated orifice space.
- Can be converted to regular Super Seal Floating unit at any time by applying pressure with rig pumps to shear the fill-up unit's retaining pin.
- Easy to operate! Easy to drill! Economically priced!

**A COMPLETE LINE OF CASING TOOLS AND MATERIALS**

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*S-3 Casing Centralizers* — designed and constructed for maximum casing centering efficiency . . . available in all casing and most tubing sizes.

*Formation Packer Shoe* — excellent for use in placing cement *above* low pressure producing formation to help protect it from cement contamination during cementing. Equipped with dual Super Seal Valves for floating casing to bottom and helping to keep cement slurry from backing up inside the casing. The Halliburton Casing Swivel allows casing rotation after setting packer to permit cleaning of well bore with wall cleaners for better cement bonding.

*Halliburton Weld-A* — an economical thread compound for locking threaded connections on the lower casing joints . . . designed to actually hold tighter than tack welding.

See your nearby Halliburton Representative for all the details on his complete line of casing equipment.

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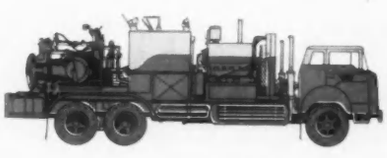
*275 Service Centers*
*. . . just minutes away*
*from your well*



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# Suppliers' notes

**W. H. Plowman,** manager of Southwest sales for **Gould Pumps, Inc.,** is now permanently located in Houston having moved from Tulsa.

W. H. Plowman

**Leon Kilgore** has been transferred from the Houston Division, **Harold Brown Company,** to Corpus Christi, Texas, and appointed division manager of the South Texas Division. **John Morgan** has been transferred from Houston to the **Harold Brown Company of California** with offices at Ventura. **Greggory Owens,** previously in the Enginering Department, has been moved to the Sales Department to work in the Houston Division. **Jerry B. Davis,** has become division sales manager of the West Texas Division, headquartered at Midland. **Mason Lilly** has been appointed chief engineer of the **Harold Brown Company of Houston,** in charge of new product development and engineering service.

**Kinder Chambers** has been promoted from district engineer to a staff service engineer in the Drilling Mud Department, Marketing Division, of **Magnet Cove Barium Corporation (Magcobar).**

**Al L. Boynton** is the new manager of Geophysical and Industrial Recording Supplies for **Southwestern Industrial Electronics (SIE), One of the Dresser Industries** in Houston.

**Robert E. Quinn** has been appointed district manager of the Axelson Hydraulic Department, California area for **Axelson Division of U. S. Industries, Inc. E. C. Swain** factory representative, formerly of Oklahoma City, has transferred to the company's office and warehouse in Odessa, Texas.

**Neal Clayton** has been added to the staff of **Index Geophysical Surveys Corp.,** Houston, as a geophysical supervisor.

**O. William Shaughnessy,** former field engineer with Mobil Oil Company, Inc., has been appointed director of Quality Control by **GSM, Inc.**

**Joseph J. Jacobs** has been appointed chief engineer by **Allis-Chalmers Manufacturing Company.** Also, **C. L. Babb** and **W. W. Weltmer** have been appointed senior engineer and senior development engineer, respectively.

**John W. (Jim) Johnson** has been transferred from Michigan City, Ind., to Dallas, by **Joy Manufacturing Company** to become manager of the company's oil field compressor Sales Department.

B. R. Wakefield

R. R. Nagel

**R. R. Nagel** has been named director of Manufacturing, Engineering, Research and Development for **Houston Oil Field Material Co., Inc. (HOMCO),** with offices in Houston. Also, **B. R. Wakefield** was appointed vice president, Special Projects for HOMCO. Wakefield also will headquarter in Houston.

**Walter H. Shealor** has been appointed assistant director of sales, International Division of **The Timken Roller Bearing Company.**

**Forest D. Richardson** has been appointed treasurer in charge of Finance and Business Administration of the **Young Radiator Company** with plants in Racine, Wis., and Mattoon, Ill.

**Philip D. McManus** has been named general manager of the **A. O. Smith Corporation's** Smith-Erie Division at Erie, Pa. McManus succeeds **Harry G. Smith,** who in planning his retirement, has resigned but has consented to serve as a consultant to the new manager. McManus, prior to his new appointment, held a position on the president's staff as controller of the corporation.

P. D. McManus

**James Cliburn, Ralph Murphy** and **Glen Tanner, Jr.,** have been added to **Plastic Applicators, Inc.'s** Sales Engineering Department.

**Buddy Moody** has joined the South Louisiana Division sales force of **Max Langston** and **C. M. (Buck) Thornton** of the **Harold Brown Company.**

**Claude W. Brown** has been named sales and technical service representative for **Grove Valve and Regulator Company,** in the states of Oklahoma and Kansas.

**Ivan R. Blauser, Jr.,** has been appointed sales representative—store area at Pikeville, Ky., for **U.S. Steel's Oil Well Supply Division.** Also, **Robert L. Cowan, Jr.,** credit manager for the Mid-Continent and Rocky Mountain areas, has completed the executive development course of the Graduate School and Financial Management at Dartmouth College.

**William Hansot** has been appointed assistant to the president of **General Analine & Film Corporation.**

**James E. Moores** has been named manager of systems and procedures at Southwestern **Industrial Electronics (SIE),** a Division of Dresser Industries.

**A. Earl Lee** has been appointed market co-ordinator of **J. I. Case Company.** Lee will co-ordinate all phases of the Case marketing operation including product development and market research.


FROM MUD CONTROL LABORATORIES

THE AMAZING NEW SALT WATER EMULSIFIER "CEOX"

Developed specifically as a surfactant for salt water muds, CEOX is a highly effective emulsifying agent that aids in retaining oil in water (up to 50% by volume). Increases penetration rate of drill bit and reduces hazards of loss of circulation (in some cases, CEOX has cut costs of oil requirements in half).

Packaged in 55 gallon drums containing 383 # net

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# New Visco Well-Treating Formula Penetrates, Loosens, Disperses Deposits in Tanks, Lines, Tubing

## Lowered pumping pressure, Tripled production, Dispersed solid paraffin... Among Spectacular Performance Results with Visco 1111

Visco 1111, on the job in oil and gas producing wells, water-injection wells and salt water disposal systems, has amazed even the most optimistic with its performance and economy. Here are a few examples of how it works to penetrate, loosen and disperse deposits of paraffinic-asphaltic compounds, carbonate scale, sodium salt deposits, iron compounds and other materials causing loss of production.

### Cuts Pumping Pressure 175 psi

Injection pressure was 325 psi on a water injection well. Foreman believed pressure was due to a tight formation, but agreed to a test of Visco 1111. Pressure is down to 150 psi—and staying there, with one-gallon-per-day dosage of Visco 1111.

### 7-Well Cleanup Nets 60 bbl. Increase

Sticking pumps, caused by scale build-up, were causing frequent rod-pulling jobs on a 7-well East Texas lease. Visco 1111 cleaned up the pumps and tubing, upped production 60 bbl. per week. Company now using Visco 1111 on all their wells in East Texas.

### Stopped Reperforating Need

On another East Texas lease, wells making high salt water with low-gravity oil tended to scale up and require periodic reperforation. Visco 1111 was given a trial on a well making only 3 bbl. oil and 20 bbl. water a day... quickly jumped daily production to 23 bbl. oil and 60 bbl. water. Cost: only $23.50 . . . as against $300 to reperforate.

### Solid Foot of Paraffin Gone

A 500 bbl. tank contained 470 bbl. oil and a 12-inch paraffin bottom—so hard that an oil thief would not drop through. 5 gallons of Visco 1111 and 48 hours later the tank went on at 0.5% B.S. & W., *and no bottom at all.*

### Easy to Use, Too!

Visco 1111 has excellent blending characteristics under a variety of field conditions, and does not gel when added to water. Your Visco Service Man will be glad to help you determine proper Visco 1111 dosages for best performance and economy on your leases. Ask him about this new well-treating product . . . or write us, today, for detailed product data.

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*A Unit of Nalco Chemical Company*
**1020 Holcombe Boulevard** **Houston 25, Texas**

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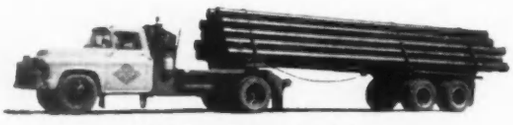
*... Serving the Oil Industry through Practical Applied Science*

Visco CHEMICALS
Visco SERVICES

As delegate to a political convention, Joe Roughneck says he found out there's more to "rigging" than he'd thought. But on home ground, Old Pro Joe knows what to expect, when he's choosing supplies for oil well drilling. Joe demands Lone Star pipe because he knows he can depend upon its tough reliability. Made to API specifications, Lone Star casing, tubing and line pipe undergoes exacting quality control and multiple testing. It's conveniently available too. Made in the heart of the oil country, Lone Star pipe is deliverable overnight to 75% of Mid-Continent producers.

**Neighbor, wherever you are, specify Lone Star and we both get a good deal.**



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**Lone Star STEEL COMPANY**

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DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

## Suppliers' notes

**W. J. Gundlach** has been appointed chief engineer for the Houston Divisions of **Mandrel Industries, Inc.** Gundlach will supervise design and manufacture of geophysical instruments at **Electro-Tech Laboratories,** and color sorting machines at **Electric Sorting Machine Company,** two Mandrel Divisions.

**Ralph T. Dosher, Jr.,** has been named manager of the Automation Products Department for **Texas Instruments Incorporated Geosciences & Instrumentation Division's** Instrumentation group at Houston.

**Lyndon P. Harmon,** sales manager for **Well Completions, Inc.,** Denver, has been promoted to vice president of the air and gas drilling engineering firm. While continuing to act as sales manager, Harmon will assume additional management responsibilities.

**L. P. Harmon**

**John B. Fowler** has been appointed field representative at Shreveport, La., for **U.S. Steel's Oil Well Supply Division.**

**C. W. Thurmon** has been assigned as salesman in Shreveport, La., office for **Jones & Laughlin Supply Division.** He previously was in El Dorado, Ark. **N. A. Myers** has been promoted from sales trainee to salesman at Lake Charles, La., for Jones & Laughlin.

**George H. Moore,** formerly manager, Industrial Sales Department, **Magnet Cove Barium Corporation (Mogcobar),** has been appointed to the newly created position of assistant vice president-Marketing, Mud Drilling Department. **Ray E. Dillman** has been appointed assistant sales manager in the northern area. **R. M. Edwards** remains as assistant sales manager in charge of Houston downtown sales office. **L. B. Gale, Jr.,** has been named to the newly created position of distribution manager, and **Myron Robertson** has been promoted from Northern Division Sales representative in the Mid-Continent Region to assistant regional sales manager of that Division.

**John Kacmarick** has been appointed general manager of **Chicago Pneumatic Tool Company's** Franklin, Pa., plant. Kacmarick will be responsible for all activities at the Franklin plant. He succeeds **H. E. Moore** who has retired but will remain at Franklin in a consulting capacity until December 31.

**John Kacmarik**

## Suppliers' notes

**James N. Stratton** was recently named area sales manager for **Milwhite Mud Sales Company.** He will make Midland, Texas, his headquarters.

**Howard Gleason,** former assistant to the president, **Southwestern Industrial Electronics (SIE), one of the Dresser Industries,** has been appointed vice president of Manufacturing.

Fred L. Magoon

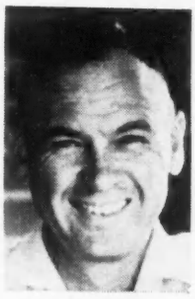
B. A. Abercrombie

**Fred L. Magoon** has been promoted to manager of Engineering and **Bolling A. Abercrombie** has been named manager of Production Planning and Evaluation, **Garret Oil Tools, Division of U.S. Industries, Inc.** These two promotions were brought about by the resignation of **V. B. Scott** who is resigning as manager of Product Development.

**Fred P. Cannon** has been appointed director of sales for **Gulf Coast Machine and Supply Company** of Beaumont. **J. C. Newman** has been appointed sales coordinator.

**Allen C. Johnstone** has been appointed field representative at Edmonton, Alta., for **U.S. Steel's Oil Well Supply Division.**

**W. H. Attlesey** has been appointed export sales representative for **Houston Oil Field Material Co., (HOMCO).** Reassignments of other personnel include: **H. H. Hughes** is now Central Division manager and also holds the position of district manager of the Houston Division. **T. C. Smith** and **Linn Galeener** have moved up to the position of technical advisors for Customer Relations. **Frank Singletary** is now director of Cutting & Fishing and Directional Drilling. **H. L. Hodge,** former city salesman for supply operations, has transferred to city sales in Houston for Cutting & Fishing. **Gustav Schmidt,** formerly Machinery Sales, is now in City Sales, Supply. **Eddie Zublin,** former export salesman, has transferred to City Sales for Directional Drilling. All are headquartered in Houston.



W. H. Attlesey

## Baker Oil Tools, Inc. Opens Two New Branches

Baker Oil Tools, Inc., recently opened two new branch stores in California and Alabama. J. H. Graham has been made sales and service engineer in charge of the new Rio Vista, Calif. branch, and B. J. Gass, who moved from Laurel, Miss., will manage the new Citronelle, Ala., branch. At the same time, J. J. Laws was promoted to the position of branch manager of the Baker Falfurrias, Texas, branch.

## BrakeSol Products Now Manufactured In Canada

BrakeSol, Inc., has recently disclosed that BrakeSol products are now being made in Canada. The products being distributed through leading supply stores include: BrakeSol Paraffin Treating Chemical for the control of wax in tubing lines and tanks; BrakeSol D-7 Demulsifier for the separation of water and salts from crude, and Stim-Form for removing water, emulsion, mud and paraffin blocks from the formation and to open up injection wells in floods to assist in secondary recovery.

Pat Curtin, BrakeSol Division treating engineer makes his headquarters in Edmonton, Alta. He will service BrakeSol products in British Columbia, Alberta and Saskatchewan provinces.

# REALL of ENGLAND

*Britain's leading specialists in commercial vehicles for domestic or overseas operation.*

**Yet another example of REALL equipment for the Oil Industry overseas. This two-compartment, two-temperature refrigerated semi-trailer with a 10-ton capacity for the transport of perishable foodstuffs has just been supplied to Iranian Oil Services Limited. It is a repeat of a previous order.**

# REALL of ENGLAND

**One of a fleet of Reall-built vans used by Hoover in Britain for the transportation of their well-known products.**

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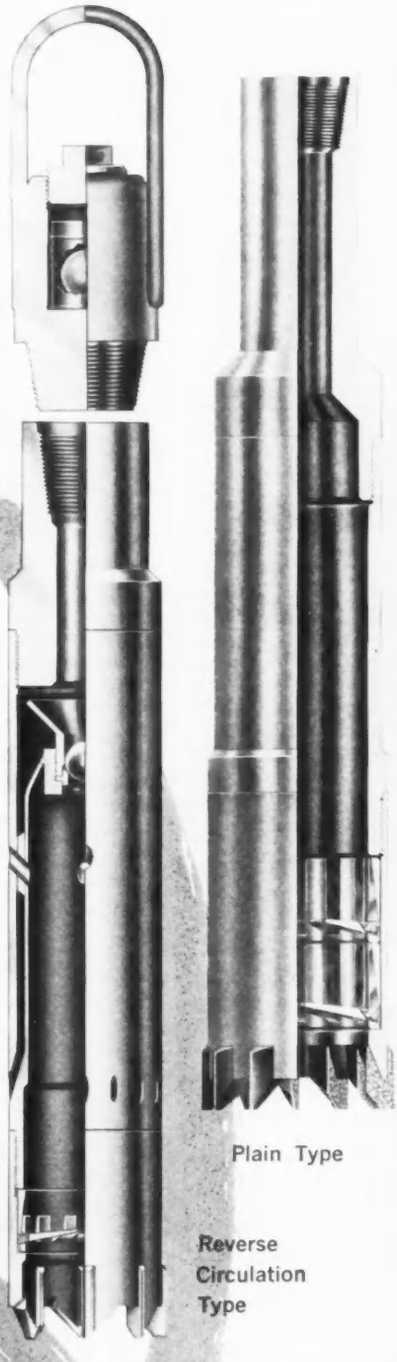
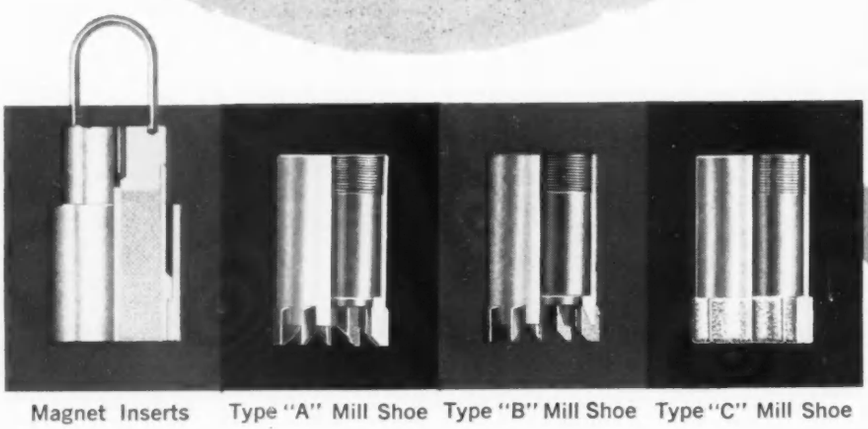


Plain Type

Reverse Circulation Type



Magnet Inserts | Type "A" Mill Shoe | Type "B" Mill Shoe | Type "C" Mill Shoe

*For over 25 years—the world's leading manufacturer of fishing and specialty tools.*

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BOWEN

25th ANNIVERSARY 1935 1960

## Suppliers' notes

### Halliburton Hosts Graduates

**The 1960 graduating class of the petroleum engineering school at the University of Industrial de Santander, Bucamaranga, Colombia, recently toured the United States and was hosted by Halliburton Company. Front row, left to right, Pedro Camargo, Milton Ruiz, Jorge Gomes, Pedro Serrano, Jario Gonzalez, Gilberto Barcenas. Back row, left to right, Professor Pedro Fernandez, Roberto McCormick, Juilo Gonzalez, Victor Castaneda, Policarpo Pico, Jose R. Villamizar and Alirio Rurda.**

**John W. Carlson** has been appointed assistant manager of the **Allis-Chalmers Manufacturing Co.'s Construction Machinery Division. James B. Codlin,** formerly chief engineer of the **Deerfield Works,** succeeds Carlson as general manager of the Deerfield Works in Illinois.

**D. K. Graham**

**H. C. Smith**

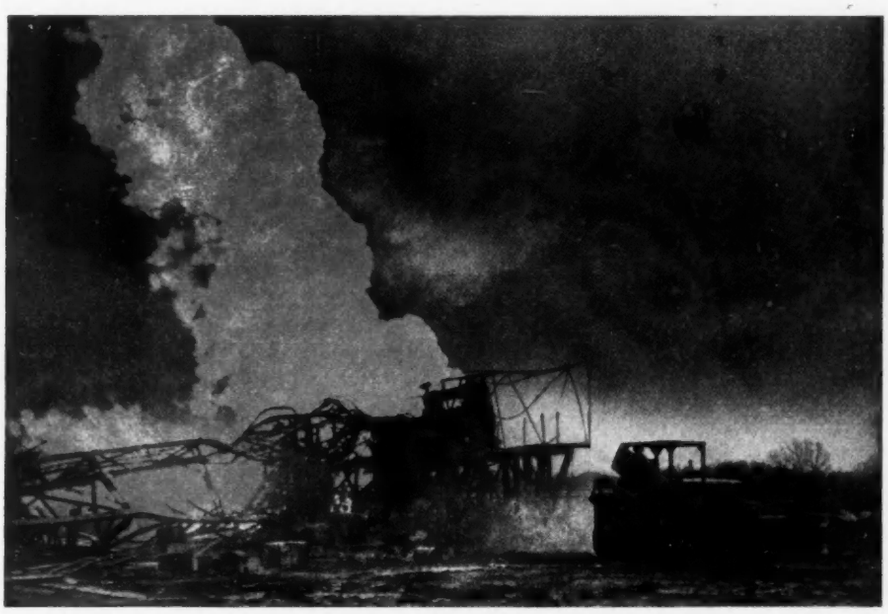
**Donald E. Graham** has been elected president of **Smith Tool Company.** He succeeds **H. C. Smith,** founder and previous president of the company, who was named chairman of the board of directors. Graham was elected executive vice president in 1952, a position he has held for the past two years.

**Winston O. Shook** and **George H. Barnes** are the newly appointed sales representatives for **Delta Tank Manufacturing Co., Inc.,** Corpus Christi, Texas, branch.

**I. John Billera** has been elected executive vice president-Operations of **U.S. Industries, Inc. He** was previously senior vice president of the company. Billera will be responsible to the chairman of the board and president for the operations of USI's 13 divisions and subsidiaries.

**I. J. Billera**

**L. T. (Lex) Shackelford** has joined **Dalminter, Inc.,** as sales representative. He will headquarter in Houston.



# A "Pit-O-Graf" MIGHT HAVE SAVED THIS WELL

A Pit-O-Graf can give adequate warning to prevent a blowout. But, it must be where the driller can see it, can take advantage of it. Here's what users have to say:

One oil company says — "Although blowout prevention is a matter of concern for the operator, the contractor, and the drilling crews, generally *the driller is the key man.*"

Another company says—"Since a pit level indicator is so important, take these precautions to get the most good out of it: Place the pit level recording instrument at or near *the driller's position on the derrick floor.*"

If the driller's responsibility is not misplaced, then he can recognize the danger signals that precede every blowout. With the Pit-O-Graf record before him, he can intelligently analyze the *rate* of gain or loss of mud as recorded and thereby direct his crew in the orderly control of the situation at hand. In this case the threatened blowout would become *one that does not happen.*

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**WARREN AUTOMATIC TOOL CO.**

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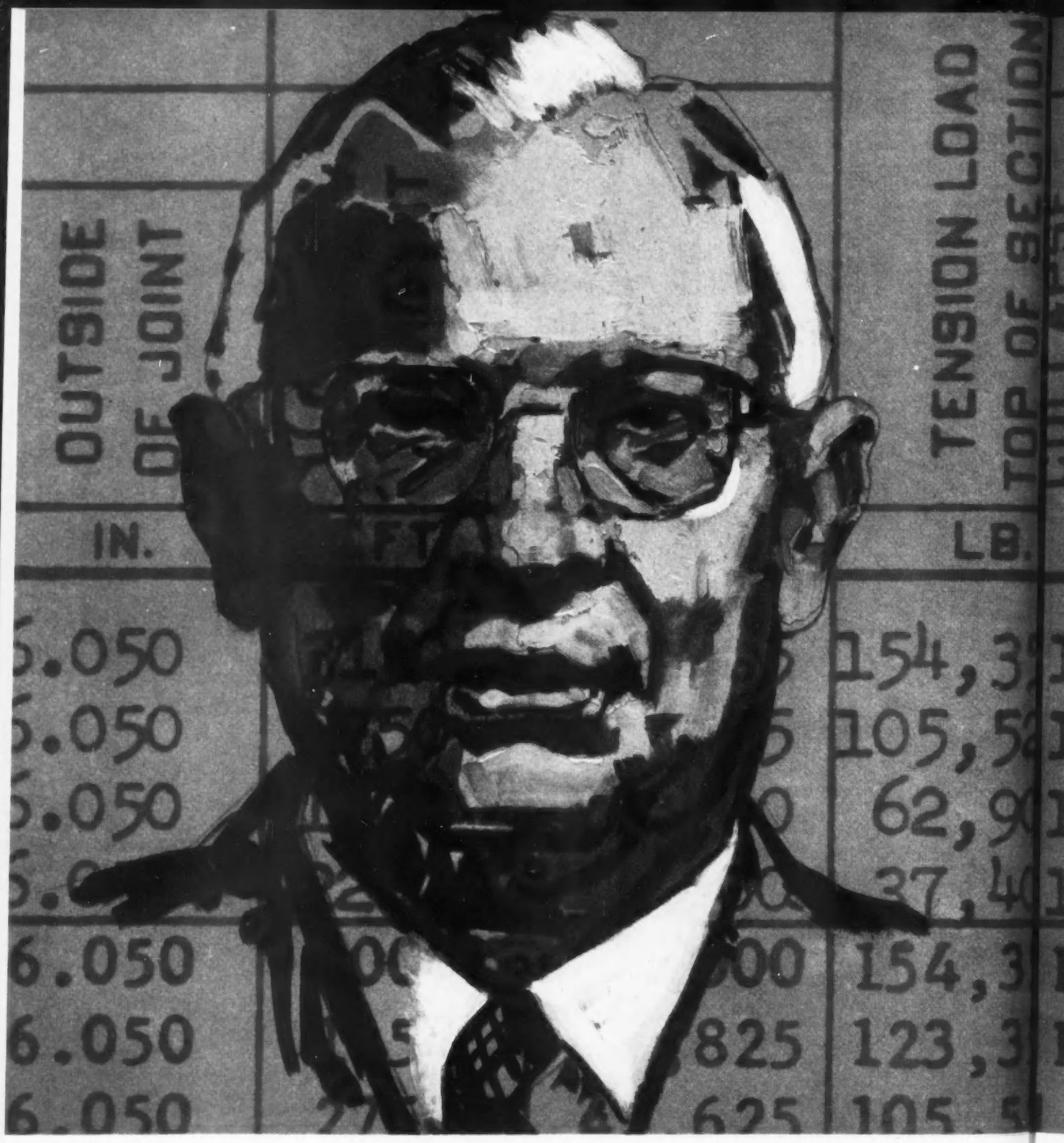
For more data on advertised products, use Readers' Service Cards, last page.

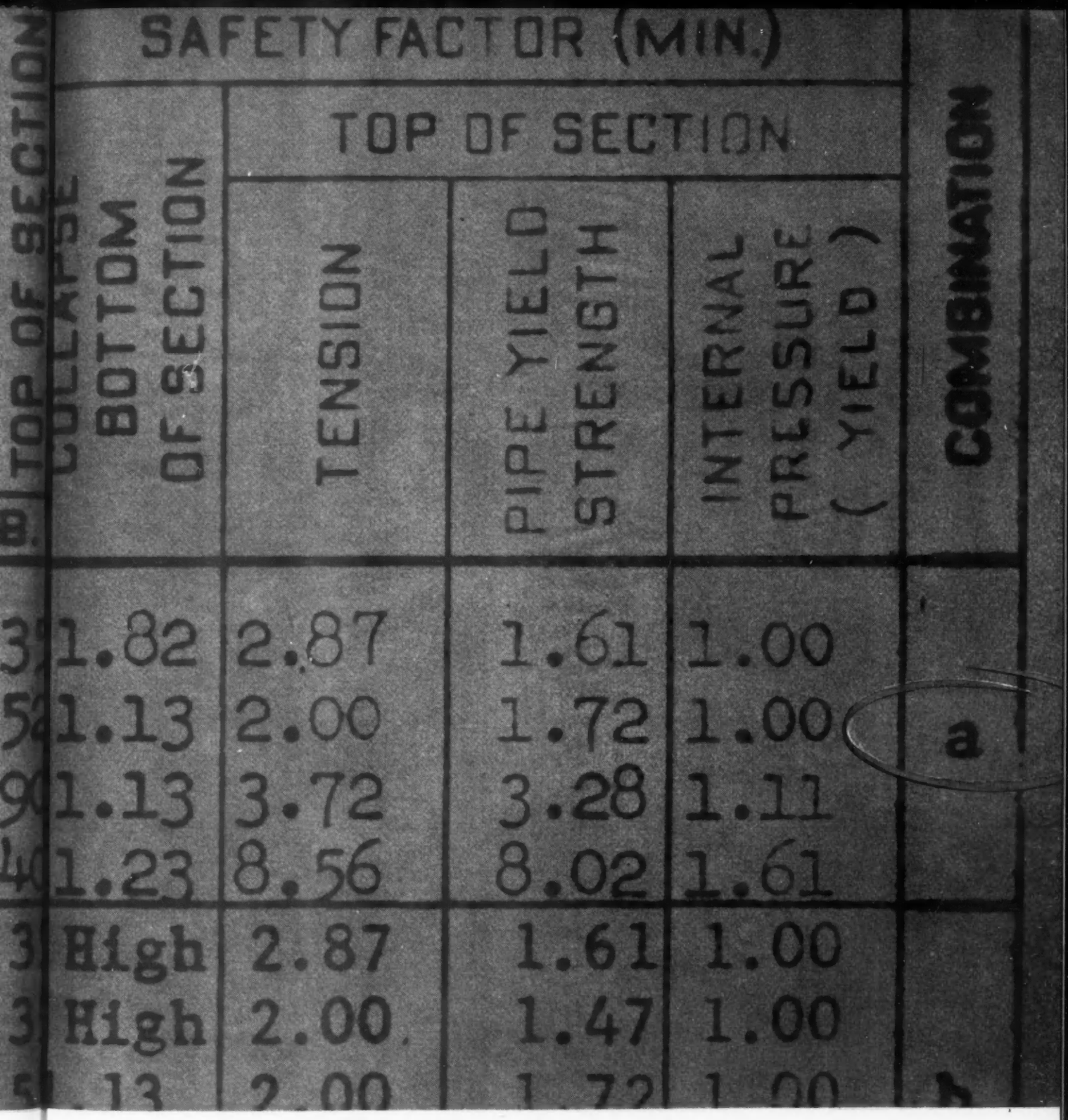



# The wizard of oil

*This National Tube field engineer is a modern-day Merlin, because he designs more economical and more efficient casing combinations.*

He does it without magic or sleight-of-hand, but with years of field experience and technical knowledge. He figures several casing combinations with razor-sharp accuracy, lists them on a form, and submits it to a customer. The customer then picks the combination that best fits his program—in this case it was combination "a."

Our field expert carefully explores the customer's operating methods. Does he run his string fast or slow? Type of equipment? Drilling technique? Location? If it's an offshore



| TOP OF SECTION | SAFETY FACTOR (MIN.) | | | | |
|---|---|---|---|---|---|
| | TOP OF SECTION | | | | |
| B. | COLLAPSE BOTTOM OF SECTION | TENSION | PIPE YIELD STRENGTH | INTERNAL PRESSURE (YIELD) | COMBINATION |
| 3 | 1.82 | 2.87 | 1.61 | 1.00 | |
| 5 | 1.13 | 2.00 | 1.72 | 1.00 | a |
| 9 | 1.13 | 3.72 | 3.28 | 1.11 | |
| 4 | 1.23 | 8.56 | 8.02 | 1.61 | |
| 3 | High | 2.87 | 1.61 | 1.00 | |
| 3 | High | 2.00 | 1.47 | 1.00 | |
| 5 | .13 | 2.00 | 1.72 | 1.00 | b |

project, he'll include an extra safety factor. This engineer's strict attention to detail results in a casing combination that promises efficient, economical and satisfactory service.

A great many customers have benefited from our experience. You can too. National Tube is the world's largest and most experienced manufacturer of tubular products. Write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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# PRECISE BOTTOM-HOLE ORIENTATION *in minutes*

WITH THE

## NEW REGAN BOTTOM-HOLE ORIENTING SUB

★ *Cuts Rig Time*

★ *Maintains Continuous Mud Circulation*

★ *Eliminates use of Sand Line and Instrument*

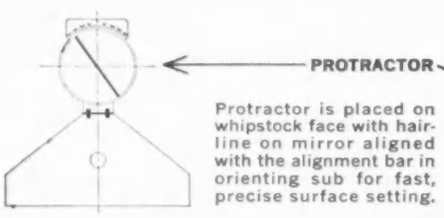
Ease of operation . . . fastest, most precise bottom-hole orientation in the drilling industry . . . all these benefits are yours when you use the Regan Bottom-Hole Orienting Sub. Field tested for nearly three years in holes up to 12,000 feet by major California drillers, this great new tool is now ready to bring its positive advantages to industry-wide drilling operations.

Featuring a pre-set splined jar one single above the deflection tool, the jar is tripped by a gravity-actuated ball. It indicates *at the surface* the correct tool orientation by shortening the drill string the length of the jar. *At no time does the ball support any weight to bind its movement or damage its race.*

For dependable hole insurance, plus fastest and most precise deflection tool orienting, check into the Regan Bottom-Hole Orienting Sub—soon.

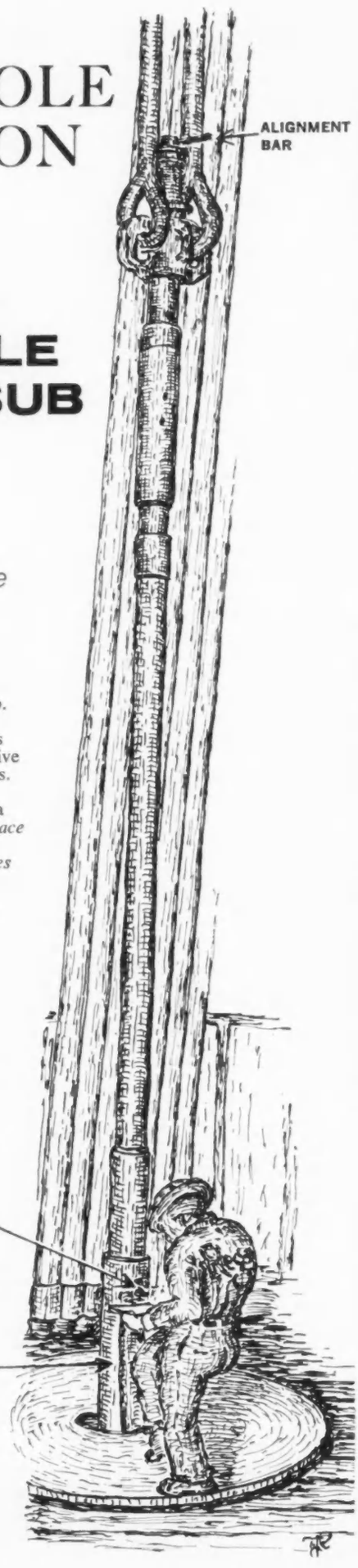
Advantages of deflection tool orientation from the *bottom* of the hole:

1. Absolute accuracy within closest tolerances.
2. Continuous mud circulation for a safe hole.
3. Elimination of time-consuming instrument runs; use and wear of sand lines.
4. Will repeat setting as many times as necessary without removing tool from hole.



PROTRACTOR

Protractor is placed on whipstock face with hair-line on mirror aligned with the alignment bar in orienting sub for fast, precise surface setting.

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## *Suppliers' notes*

**R. C. Bown** has been appointed manager of sales for **Allis-Chalmers Manufacturing Company's Control Department.** Bown succeeds **G. G. Brooks** who transferred to Allis-Chalmers associate company, **Consolidated Systems Corporation. W. G. Williams** succeeds Bown as manager of Allis-Chalmers Rectifier Section.

**Carroll R. Justice** has been appointed vice president-sales of **U.S. Steel Products Division of U.S. Steel Corporation.**

**William S. Davis** has been named vice president of **Harrisburg, Inc., Oil Field Sales & Service.**

**Hellmuth (Dick) Strauss** has been appointed vice president and general sales manager of **Walworth Company.** Strauss succeeds **Harold Brown,** vice president and general sales manager who has resigned.

**James E. Ray** and **Clyde M. McAfee** have been appointed engineers by **Delta Tank Manufacturing Company, Inc.** Both will headquarter in Delta's Houston office.

### Equipment Sales & Service Newly Formed Houston Firm

Equipment Sales & Service Company, headed by Charles (Pat) Ingle, longtime sales and service engineer at McEvoy Company, has been newly organized in Houston as a new firm to meet the needs of oil producers in the Houston area.

According to the announcement, the new firm ESSCO, offers a unique and economical service to operators of all types of valves and wellhead equipment. Using only manufacturer's recommended parts, lubricants, compounds and factory trained servicemen, each unit available in this new service is specially built with compressor, lubrication guns, small tools, extra lubricant and spare parts mounted on a skid so that the unit can be used on a truck or on a boat for servicing of land or offshore units.

### Allis-Chalmers Creates Six New Sales Regions

Allis-Chalmers Manufacturing Company has organized six construction machinery sales regions and created the new position of general products manager within the Construction Machinery Division of the firm.

The separate sales regions have been designated geographically as Northwest, Western, Central, Eastern, Southern and Northeast to effect a closer relationship between customers, dealers and the company. Each region covers the sales territories of two Allis-Chalmers Construction Machinery branch offices. Heretofore, there were two regions, Eastern and Western, covering six branch office sales territories each.

H. T. Laramore has been appointed to the newly-created position of general products manager of the Allis-Chalmers Construction Machinery Division.

# WATER

***PRESSURE MAINTENANCE INJECTION, WATERFLOOD, SURFACE, SUBSURFACE, & OFF-SHORE DISPOSAL REQUIRE CLEAR, CLEAN WATER***

The problem is to treat effluent or produced water so that it will be harmless to equipment, underground formations, and wildlife and watersheds—a problem made tougher by the fact that no two water treating problems are alike.

Flexibility and adaptability of BS&B's extensive line of Aqua-Kleener units enable you to match up a variety of solutions with the variety of water treating problems encountered, from an installation composed of a single filter and storage tank to complete open and closed systems.

***THE BS&B AQUA-KLEENER LINE:***

*Treaters, Oil Skimmers, Free Water Knockout Tanks, Backwash Tanks, Filters, Filta Wash Tanks, Phanto-Matic Backwash Controllers (for automatic filtering), Aerator/Degasifiers, Raw Water Treating Tanks, Bolted Steel, Welded Steel, Wood or Poxyglas Storage Tanks.*

Ask your local representative for full information or write to BS&B, Dept. 1-B10, P. O. Box 1714, Oklahoma City, Okla.

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**GEOPHYSICAL ENGINEERING CO.** TRANSIT TOWER SAN ANTONIO CApitol 6-1393

**Petty's patented* horizontal stacking technique verifies each subsurface point with multiple ray paths. Since only the reflection point is common to all, noise is greatly reduced and maximum record clarity is assured.**

*U. S. Patent No. 2,732,906

## *Suppliers' notes*

### Western Geophysical Co. Moves to New Headquarters

Western Geophysical Company of America, a subsidiary of Litton Industries, has moved into its newly completed four-tory headquarters building in Los Angeles, adjacent to its laboratories and shops. Western's headquarters facilities, including geophysical and electronic research, occupy approximately 37,700 square feet of floor space.

The company is engaged in worldwide seismic exploration for oil, with division and survey offices in both hemispheres.

### Bovaird Recently Named Gardner-Denver Distributor

Davis D. Bovaird, president of the Bovaird Supply Company, Tulsa, and Gifford V. Leece, president of the Gardner-Denver Company, Quincy, Ill., have announced that Bovaird has become a stocking distributor of Gardner-Denver mud pumps and other petroleum equipment.

The Bovaird Supply Company is authorized to distribute Gardner-Denver equipment in all of Bovaird's stores located in Oklahoma, Kansas, Texas, New Mexico, Louisiana and Illinois.

### Larkin & Company, Inc. Moves and Changes Name

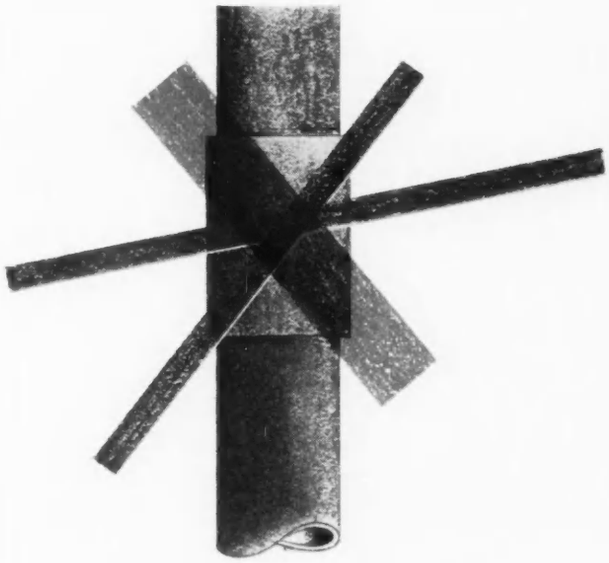
Larkin & Company, Inc., of Butler, Pa., has recently announced the transfer of all their production facilities to larger quarters in Wellsville, N. Y. The company also announced that it will operate under its new name, The Butler-Larkin Company, Inc.

The company will continue to manufacture present line of oil, gas and special well production equipment. Larkin maintains branch offices and warehouses in Parkersburg, W. Va., Olney, Ill., and Bartlesville, Okla. Other warehouse stocks are made available in Texas and Florida.

### Grant Oil Tool Co. Opens New Texas Office

Grant Oil Tool Company has opened its eighteenth branch office in Kilgore, Texas. The branch was established to provide the drilling industry in the Ark-La-Tex area with quick service in Grant specialized downhole tools and MacClatchie slush pump valves and seats.

Drew Johnson, formerly Grant manager at Casper, Wyo., has been placed in charge of the Kilgore branch. The new Ark-La-Tex branch is under the supervision of George Carter, recently appointed division manager.



# NEW!

# THE ATLAS PIPE "COMPACT" TUBING JOINT

## Offers Cost-Saving Possibilities

Tubing strings for shallow and medium depth wells without couplings are now possible by using the Atlas Pipe "COMPACT" tubing joint. This integral joint uses API threads interchangeable with tubing now in use.

You get more "string" per dollar with the Atlas Pipe "COMPACT" joint. Available in sizes 1" thru 2⅞" tubing and 3½" casing. Write for complete technical data.

**ATLAS PIPE INC.**

A DIVISION OF ATLAS BRADFORD COMPANY

511 First City National Bank Bldg.
CApitol 3-4314, Houston 2, Texas

•

Corpus Christi Phone: TUlip 4-6371

•

Tulsa Phone: Diamond 3-6791

Heat treated alloy steel. Throws better, spins faster, lasts longer. Regular link or super twist in popular lengths, sizes.

Regular Link

Super Twist

AT SUPPLY STORES EVERYWHERE!

DRILLING EQUIPMENT MFG. CO. DEMCO OKLAHOMA CITY, OKLA. U.S.A.

DRILLING EQUIPMENT MANUFACTURING CO.

845 S.E. 29th • OKLAHOMA CITY, OKLA.

for LEAKPROOF PRESSURE-TITE Connections...

TiteSeal®

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion and joint seizure.

7 BASIC BLENDS

LIQUID WRENCH

LOOSENS RUSTED BOLTS

A powerful blend of fast-acting solvents that literally" melt the rust away" —safe on all metals and alloys.

RADIATOR SPECIALTY CO.
CHARLOTTE, N. C.


## Suppliers' notes

### BJ Holds Annual Management Meeting

**John B. Merritt, president of BJ Service, Inc., headed up the recent annual meeting held by the company whereby company executives formulated operating plans for the next 12 months. Present at the meeting were, seated left to right: W. T. Box, Merritt, C. Z. Hughes, C. L. Sorrentino, C. R. Cross, R. P. Maddox, A. T. Jones, J. C. Jackson and C. F. McMahan. Standing, left to right: L. H. Kaltenbeger, B. L. Crone, R. H. Jackson, C. W. Ludwig, C. C. B. Moody, J. T. Streger, J. L. Replogle, M. B. Riordan, Al Graff, J. L. Buster and A. M. Birnie.**

### Tube-Kote, Inc., Begins $300,000 Plant Expansion

Tube-Kote, Inc., cleared ground and construction was started recently on a $300,000 plant expansion in Harvey, La. The new facilities will include the most modern and efficient equipment for cleaning, coating, baking and inspecting oil field tubular goods, according to the announcement.

Tube-Kote, Inc.'s headquarters are in Houston with plants and services facilities throughout the active oil areas in the U.S. and Canada.

### Eastman Named Exclusive Distributor of National Line

Eastman Oil Well Survey Company has been appointed exclusive prime distributor of Gammaloy Drill Collars for export by The National Supply Company. Eastman will actively promote the sale and use of the Gammaloy collars through its world-wide service organization. The appointment by National followed the introduction of its improved collar.

### Continental-Emsco Opens Two More Pump Shops

Continental-Emsco Company has opened two pumps shops, one in Countyline, Okla., and one in Henderson, Ky. Both shops are completely stocked with new D+B Pumps and parts for repairing all types of bottom-hole pumps. Field service is also available.

The Countyline shop is located in the fringe area of three C-E stores, Lindsay, Healdton and Duncan, Okla. B. D. Adams has been named pump shop fore-

### Jones & Laughlin's New Canadian Store

**This is Jones & Laughlin Supply Division's newly opened supply store at Fort St. John, British Columbia. It is included within J&L's Western District, Canadian Region, with district headquarters at Edmonton, Alta., and regional headquarters at Calgary.**

# COMPARE

## CAPITOL FORGED STEEL UNIONS

## ...with any other union you may be using!

**COMPARE** the engineering and construction . . . ALL CAPITOL forged steel 3000# unions are made to AAR dimensions. Special attention is given threading, U. S. Army and Navy gauging practices on pipe threads guarantee better than normal industry standards. Burnished female seat increases surface hardness and prevents galling because of hardness differential, thus assuring a leak-proof joint regardless of repeated make-ups.

**COMPARE** material and quality . . . Capitol F. S. unions meet ASTM-A105 steel Grade II specifications. Each 3000# union is individually pressure tested to assure a leak-proof connection. Each is clearly identified for 3000# CWP or 900# steam pressure, size, and stamped with the CAP trade mark.

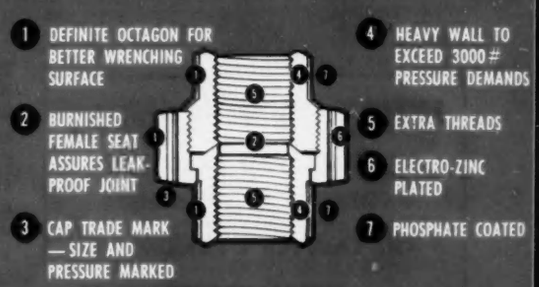
**COMPARE** finish and workmanship . . . Male and female parts are protected by phosphate coating, nut is Electro-Zinc plated. All three parts are sharply defined octagon shape for better wrenching surface.

Only by actual comparison can you fully realize the extra quality engineered into the Capitol 3000# F.S. union. Designed to meet the most exacting demands and produced by specialists to the highest standards.

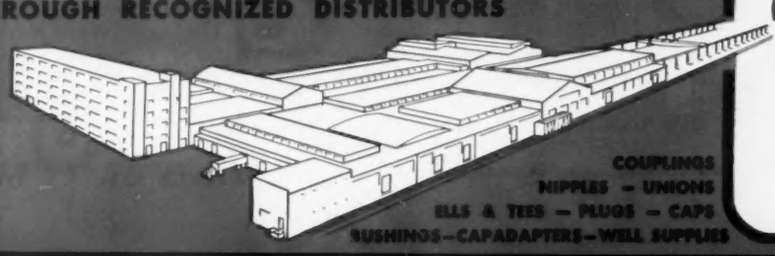
You can depend on CAPITOL unions for your most critical installations.

Available in all sizes from ⅛" to 2" inclusive, either screwed or socket weld types. Conveniently packaged, for easy handling and inventory at no extra cost. Specify CAPITOL and COMPARE.

**EACH INDIVIDUALLY PRESSURE TESTED**


1 DEFINITE OCTAGON FOR BETTER WRENCHING SURFACE
2 BURNISHED FEMALE SEAT ASSURES LEAK-PROOF JOINT
3 CAP TRADE MARK — SIZE AND PRESSURE MARKED
4 HEAVY WALL TO EXCEED 3000# PRESSURE DEMANDS
5 EXTRA THREADS
6 ELECTRO-ZINC PLATED
7 PHOSPHATE COATED

**SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS**



COUPLINGS
NIPPLES — UNIONS
ELLS & TEES — PLUGS — CAPS
BUSHINGS—CAPADAPTERS—WELL SUPPLIES

**CAPITOL MANUFACTURING CO.**
DIVISION OF HARSCO CORP.
COLUMBUS, OHIO

## Suppliers' notes

man, and W. M. Golden is the D+B Production Equipment specialist.

The store at Henderson, Ky., was enlarged to provide space for the new D+B Pump Shop. This installation enables C-E to have pumps in all its Tri-State District stores, including Illinois, Indiana and Kentucky.

## WORLD OIL'S Trading Post CLASSIFIED ADVERTISING

**RATES: Regular Classified** (undisplayed) set in this size type: 20 cents per word. Minimum charge $4. Blind box address in our care counts six words. Replies forwarded without charge. **Display Classified ads,** set in suitable larger type with ruled border, $13.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance.** Send copy and checks to: Trading Post Classified Section, World Oil, P. O. Box 2608, Houston, Texas.

### FOR SALE

**OIL WELL CEMENTING RIG**

For Sale; Shallow well rig approx. 2500 Ft.) Eight cylinder Chrysler Indus. engine, GASO 4/6 pump, three speed transmission, Four cylinder Continental for water mixing pump, all complete with valves, fittings and piping. Unit mounted on G.M.C. 6/6 truck.

Ideal for shallow water flooding field.

**M. & H. Oil Well Cemt. Co., 509 So. 31st., Corscana, Tex., Phone 4-6371**

■ Trailer Mounted Double Drum Rotary Drilling Rig Complete Ready To Work Ideal for 3500 Foot Drilling or 7000 Foot Workover Priced To Sell Desco, Inc., Box 4423, Oklahoma City, Oklahoma. Phone OR 7-4949

### LEASES, DRILLING ACREAGE, ETC,

■ Drilling Deal Wanted. Robertson Co.: 2,223 acres, M. C. Rejon Survey; 20 acres Marques 11 Leagues; 20 acres Grande 11 Leagues. Kinney Co.: 30 acres Bl 5, I. & G. N. Ry. Co.; 10 acres, Survey 202, Abst. 1619, Cert. 9019. Grantee T. F. Corry. Val Verde: 40 Bexar School Land, Survey 201, Abst. 135; 40 acres, Blk. 5, I. & G. N. Ry. Co. Box 217-W, WORLD OIL, Houston, Texas.

■ Have thousands of acres in West Virginia and Ohio to farm out at once. David Law. Phone: HU 5-6446, 716 Union Trust Building, Parkersburg, West Virginia.

### SITUATIONS WANTED

■ Capitol needed to drill offset production in West Virginia and Ohio. If you have the dough, I have the know. David Law, Phone: HU 5-6446, 716 Unon Trust Building, Parkersburg, West Virginia.

**WHAT DO YOU NEED?**

*AVAILABLE TO INDUSTRY:*

**PRODUCTION MANAGER**
—Personnel Director—
**OIL LAWYER - LANDMAN**

**METALLURGIST**

Eminently Qualified – Gilt Edged References
Resumes Upon Request

**BUDD** SPECIALIZED EMPLOYMENT **AGENCY**

CA 7-1221 518 West Bldg. Houston, Texas

### NOTICES - SERVICES

■ FINANCIAL—Investment Banking Houses and Underwriters reached. Confidential. You can send the details of your proposition direct or thru your attorney to Consultant 817—51st Street, Brooklyn, N. Y.

# NEW books, maps and movies

**REPORT OF INVESTIGATIONS NO. 41 STRATIGRAPHY OF THE BLACH RANCH—CRYSTAL FALLS SECTION (UPPER PENNSYLVANIAN), NORTHERN STEPHENS COUNTY, TEXAS,** Bureau of Economics Geology, The University of Texas, Austin, (paper cover only) $1.25.

This publication is the result of careful geologic mapping of the area concerned in an effort to clarify ambiguous type localities, establish adequate type reference sections for several limestone members, and provide stratigraphic data which will aid in future regional studies.

**INDEX OF OIL-SHALE AND SHALE-OIL PATENTS:** 1946-56, Bulletin 574, A Supplement to Bulletins 467 and 468, (In Three Parts), II. United Kingdom Patents, United States Government Printing Office, Washington, D.C., Simon Klosky, 40 cents.

It is the purpose of this bulletin to abstract the patents issued by the United States, the United Kingdom and Europe from 1946 to 1956, inclusive. A few older patents omitted in previous bulletins have been included.

This part of Bulletin 574 contains 180 United Kingdom patents that relate to retorting (and distilling underground), refining, and utilization of oil shale and its products. The largest single group relates to fluidized handling of shale. The patents are arranged numerically by country, and an alphabetical list of inventors and assignees follows them. A classified list of all the patents will be included in Part III, European patents. Part I was published earlier in 1958.

**VERMICULITE IN CENTRAL TEXAS,** Bureau of Economic Geology, The University of Texas, S. E. Clabaugh and V. E. Barnes, 50 cents.

Vermiculite deposits discussed in this paper are chiefly in Precambrian metamorphic rocks situated in Llano County and adjacent parts of Mason, Gillespie and Burnet counties; there are minor occurrances in Blanco and San Saba counties. Various events leading to formation of the deposits are discussed as well as the potential economic development of the deposits.

**FRANCISCAN CHERT IN CALIFORNIA CONCRETE AGGREGATES,** Department of Natural Resources, Ferry Building, San Francisco, Harold B. Goldman, California Division of Mines, 50 cents.

This paper discusses the nature and extent of observable alkali-aggregate reactions in concrete built with aggregate containing chalcedonic chert derived from the Franciscan formation. Also, presents data that indicate that these aggregates are not to be considered potentially active because of the Franciscan chert is not present in large enough proportions to cause harmful expansions. Table by Ira E. Klein.

**GEOLOGIC QUADRANGLE MAP NO. 23 GEOLOGY OF VAN HORN MOUNTAINS, TEXAS,** Bureau of Economic Geology, The University of Texas, Page C. Twiss, 75 cents.

As with other maps of this series, rock units are shown in color and there are two structure sections on the map sheet. The accompanying text discusses stratigraphy, structure and economic geology. Map scale, 1:48,000.

**THE OIL DEPLETION ISSUE,** Petroleum Industry Research Foundation, Inc., New York, John H. Lichtblau and Dillard P. Spriggs, $2.60.

The percentage depletion tax deduction for crude oil producers is essential for the maintenance of existing price levels for gasoline and other oil products. Without this tax feature, exploration for oil would be uneconomical at today's costs and prices. Hence, the elimination or substantial reduction of the current percentage depletion rate would necessitate an increase in the price which consumers pay for their oil products.

These are among the main conclusions of a comprehensive study of all aspects of petroleum depletion made by the Petroleum Industry Research Foundation, Inc. The results are contained in this book, **The Oil Depletion Issue.**

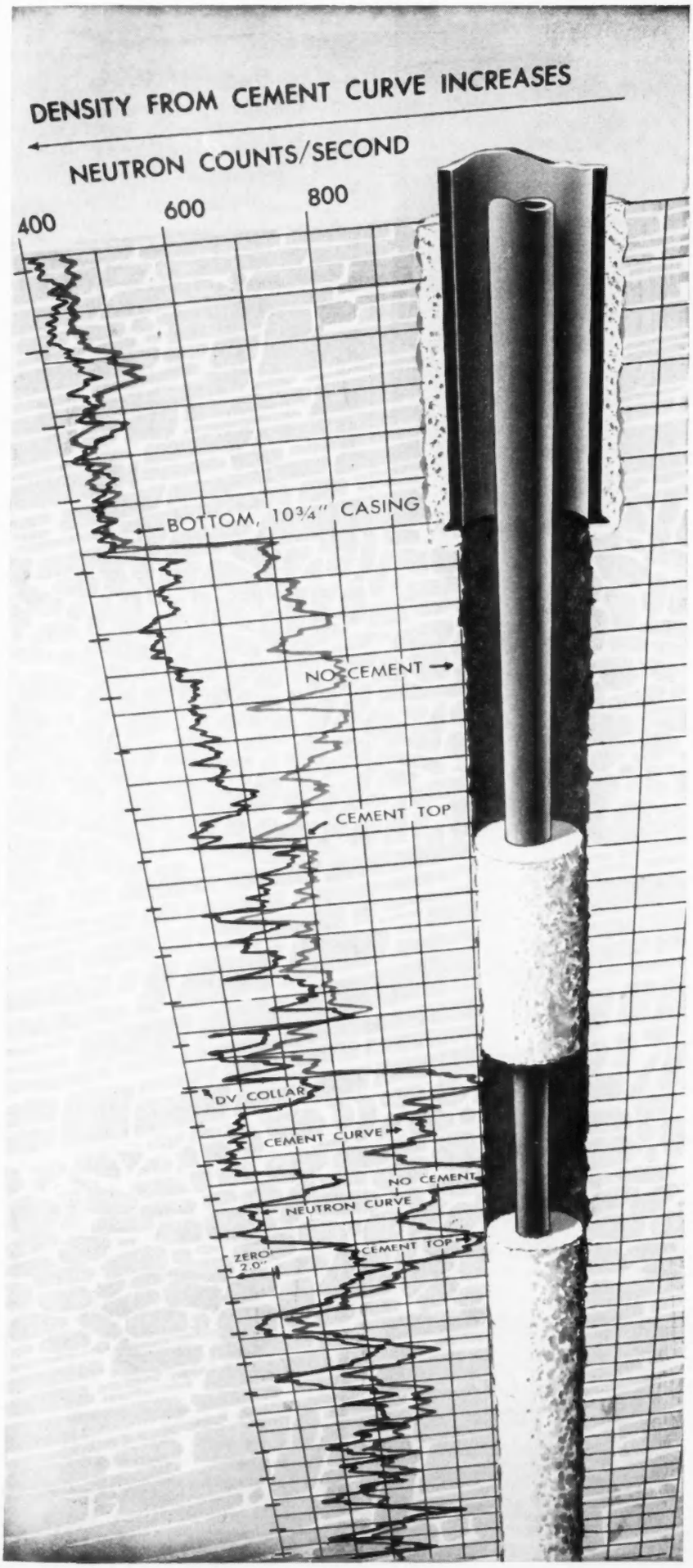
**CORRELATION OF THE OGALLALA FORMATION (NEOGENE) IN WESTERN TEXAS WITH TYPE LOCALITIES IN NEBRASKA,** Bureau of Economic Geology, The University of Texas, John C. Frye and A. Byron Leonard, 75 cents.

The lithology of the formation from Nebraska to central western Texas is discussed, criteria for correlation are considered and the work on fossil vertebrates, mollusks and fossil plant seeds is briefly reviewed, with the purpose of correlating the Ogallala formation of central western Texas with previously recognized type localities in Nebraska.

Classification problems are discussed and it is concluded that rock-stratigraphic subdivision of the Ogallala of Texas is not usable regionally, whereas floral zones are recognizable throughout the High Plains.

**1959 OIL AND GAS FIELD EXHIBITS,** Rhinehart Oil News Company, Dallas.

This supplement contains 151 pages of exhibits submitted during 1959 to the Texas Railroad Commission for MER, injection projects and special field rulings.




# McCullough

## NUCLEAR CEMENT LOG

*with Scintillometer* ®

*–lets you* SEE

*your cement column*

Here's an improved cement locating log that accurately "pictures" the cement column in your well. It will identify the presence of the cement column, confirm the quality of the job, locate cement tops, indicate uncemented sections and possibly detect channeling. It is equally effective in new wells or in old wells of any age.

The McCullough Cement Log records a curve which reflects the density of the material behind the casing. Thus, the location and characteristics of the cement column, when it differs in density from the displaced fluid, can accurately be determined.

This log is usually run on the same trip into the well with other nuclear well surveys, thus requiring no extra rig-time. In fact, the cement curve can be one of six separate logs, all revealing different down-hole information, that may be obtained on a single run without coming out of the hole. Also, it is very economical, price-wise, when run in combination with other nuclear logs.

Proved thoroughly effective on hundreds of jobs, the McCullough Cement Log is being adopted as standard procedure for determining the effectiveness of the primary cement job, checking squeeze jobs and for use in future workover or remedial operations.

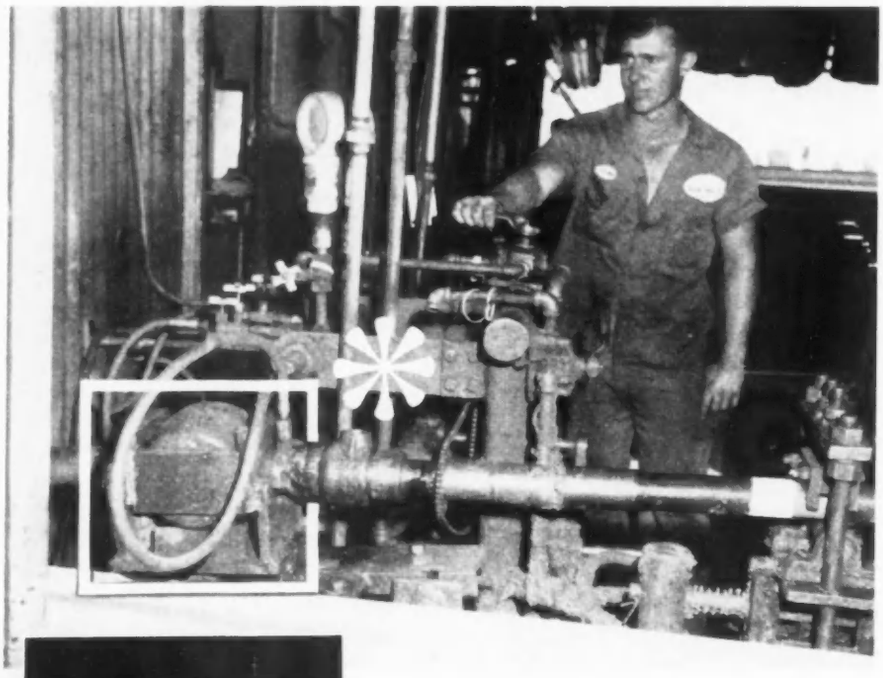
**The Cement Log shown at the left is made up of sections of an actual log run in 5½" OD casing from 3800' to surface. All information shown is exactly as it appeared on the original log.**

# McCullough

## TOOL COMPANY

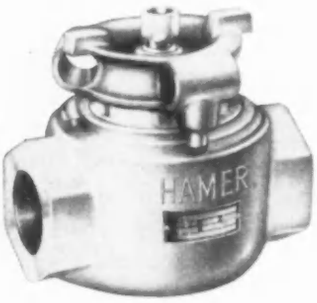
*Los Angeles • Houston • Edmonton*

*Cable Address:* MACTOOL



# HAMER

## . . . only valve to stay in service, operating 800 times per day at 10,000 psi.




Hamer "D" Series Plug Valve

Hardy-Griffin Engineering Corporation's program of testing 800 joints of oil field tubing a day at pressures of 10,000 pounds had been a valve killer with failure often occurring two or three times a day.

A HAMER "D" SERIES 2" MODEL DR150W PLUG VALVE was placed in service in January, 1959, and OPERATED FOR THREE MONTHS WITHOUT MAINTENANCE. The segments were then reversed and used another three months, then replaced. The HAMER Valve always seals bubble tight.

For reliable valve service talk to your Hamer Valve specialist.

✱ Chiksan Swivel Joint allows quick coupling of pipe to pressure unit . . . holds pressure without leaking.

WECO WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS
Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION
HV-4-60

WECO UNIONS

CHIKSAN SWIVEL JOINTS

HAMER LINE BLIND VALVES

HAMER PLUG VALVES

## Squeaks

### Not So Crazy

A psychiatrist visiting an insane asylum noticed a patient all alone in a corner, busily scratching. "Why do you spend your time scratching yourself?" he asked.

"Because," said the inmate, "I'm the only person in the world that knows where I itch."

### Just Call Him Sport

A group of friends asked the town alcoholic why he had the urge to drink all the time. "Well," he slowly drawled. "It really isn't as bad as you make it out. Look at it this way. If you get drunk in bars . . . you are called a drunk. If you get drunk at the country club . . . you're called a sport . . . so . . . just call me a sport."

### Finding Out Early in Life

Father coming home after a long day at the office to find his small son seated on the front steps of the house looking very dejected. "What's the trouble, son?" he inquired.

"It's your wife," replied the boy. "I can't get along with her."

### Typical College Graduate

A new employe reported for work and the boss told him to pick up the broom and sweep out the office.

"But, sir, I'm a college graduate," the youth said.

"Oh, well," the boss said, "give it to me. I'll show you how."

### That's Life in Russia

The newspaper *Pravda* is running a contest for the best political joke. First prize: 20 years.

### Speaking Financially

"Do you live within your income?"

"Certainly not. I have all I can do to live within my credit."

### Lord and Master

The man who brags, "I run things in my house," usually refers to the lawn mower, vacuum cleaner, washing machine, baby carriage and errands.

SECONDARY RECOVERY

PETROLEUM ENGINEERS
STEPHENS ENGINEERING
WICHITA FALLS, TEXAS

RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 723-2167

## *Squeaks*

### Elementary Dr. Watson

Sherlock Holmes: "I see you have donned your winter underwear, Watson."

Dr. Watson: "Amazing Holmes! How did you know?"

Sherlock Holmes: "You forgot to put on your pants, old boy!"

### One Bad Note And . . .

"I'm warning you," said the exasperated piano teacher to his pupil, "if you don't behave yourself, I'll tell your parents you have talent!"

### A Night With The Fellas

Mr. Jones believed he was entitled to one night out alone each week. So every Tuesday night he went out. One Tuesday he went out and did not return for seven years. When he did return his wife was so happy to see him that she phoned all her friends.

"What are you doing?" asked Mr. Jones.

"I'm arranging a welcome home party for you tonight."

"What?" protested her husband. "It's Tuesday—my night out."

### Overheard on a Bus

"You know, I wouldn't say anything about her unless it's good and, oh boy, is this good!"

### It's That Time Again

At a recent political meeting a well known Republican was speaking, says the *Wall Street Journal*. He remarked that his method of obtaining votes for the Republican party was to give every taxi driver a big tip, then tell him:

"Vote Republican."

"I think my way is better," said a colleague. "I give no tip at all and tell them to vote Democratic."

### Just Being Neighborly

"George, I don't think the man next door likes to hear Junior play his drum."

"What makes you think so?"

"Well, this afternoon he gave Junior a pocket-knife and asked him if he knew what was inside the drum."

### Long Arm—But No Law

"Gee, I couldn't sleep a wink last night with that window shade up."

"Why didn't you pull it down?"

"What! Do you think I can reach across the street?"

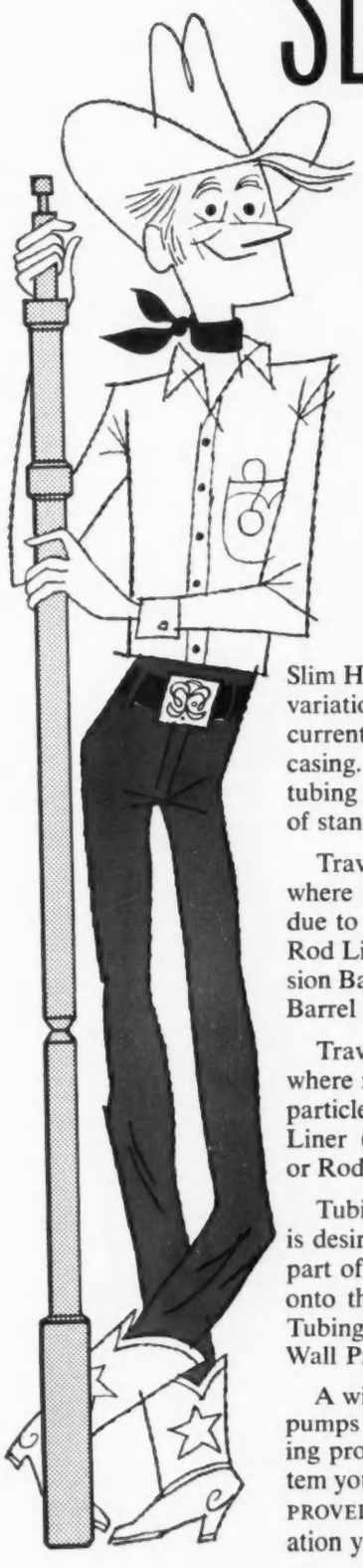
### All Right . . . Rise and Shine

A draftee after his first night in an Army barracks was shaken by his platoon sergeant. "It's four-thirty," bellowed the sergeant.

"Four-thirty," gasped the draftee. "Man, you better get to bed. We got a big day tomorrow."

### A Talking Quacker

Angry wife: "One of the ducks you were out shooting yesterday called and left her number."

SLIM HOLE PUMPS

"Well-proved"

Slim Hole Completions are essentially scaled down variations of conventionally sized well bores. A current trend being the use of 2⅞" O. D. tubing as casing. A pump for these completions where small tubing is used is necessarily a scaled down version of standard A.P.I. type pumps.

Traveling Barrel Rod Pumps for installations where sand or solid particles cause pump to drag due to wedging. These pumps can be furnished as Rod Liner Traveling Barrel (R. L. T.), Rod Precision Barrel (R.W.T.) or Rod Heavy Wall Precision Barrel (R.H.T.).

Traveling Plunger Rod Pumps for installations where no difficulty is encountered by sand or solid particle. These pumps can be furnished as Rod Liner (R.L.B.), Rod Precision Barrel (R.W.B.) or Rod Heavy Wall Precision Barrel (R.H.B.).

Tubing pumps are used where maximum volume is desired. The barrel screws onto, and becomes a part of, the tubing string while the plunger screws onto the rods. These pumps can be furnished as Tubing Liner Pumps (T.L.E.) or Tubing Heavy Wall Precision Barrels (T.H.E.).

A wide variety of materials is available for these pumps to provide combinations to meet all producing problems. Regardless of the rod pumping system you should choose, installations of these WELL PROVED PUMPS will give you the trouble-free operation you desire.

WRITE FOR BULLETIN 206

PACIFIC

CENTRIFUGAL PUMPS FOR PETROLEUM, CHEMICAL, UTILITY & GENERAL INDUSTRIES

DRESSER INDUSTRIES INC.

OIL • GAS • CHEMICAL ELECTRONIC • INDUSTRIAL

**PACIFIC PUMPS**

*Inc. . . A Division of Dresser Industries, Inc.*

HUNTINGTON PARK, CALIFORNIA

Mid-Continent:
1358 So. Sheridan Ave., Tulsa 12, Oklahoma
Pacific Pumps of Canada, Ltd.,
Edmonton, Alberta

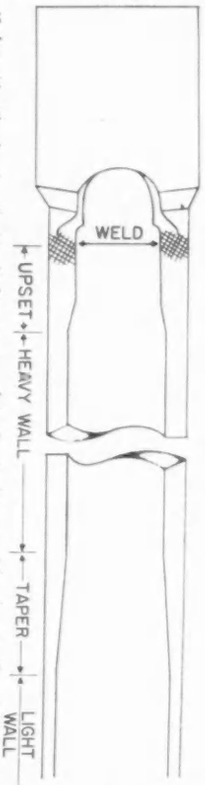



For more data on advertised products, use Readers' Service Cards, last page.

# NEW equipment and services

## Dual Weight Drill Pipe

A revolutionary new drill pipe design which gives a combination of strength and light weight has been made available. Design involves redistribution of steel in pipe. Dual Weight can: Reduce the weight per foot of drill strings; stretch light rigs 12 to 27 percent, according to drill string's length; reduce size and initial cost of hoisting equipment. (Pittsburgh Steel Company. Supplements data on Pages 4501-4520 and 3393, 1960-1961 Composite Catalog.)

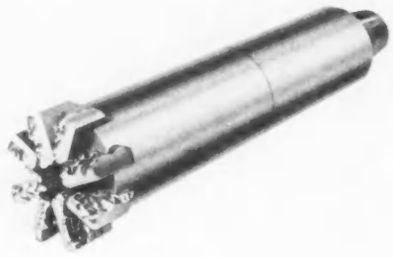



***For more data, circle E1 on postcard***

## New Chemical Injector

An advanced design beam-operated chemical injector is now available. The injector, for use on pumping wells, is powered by the walking beam through a rod or cable connection to the operating arm on the injector. Drive mechanism, contained in a dustproof housing, operates in an oil bath. Fluid piston, equipped with a return spring, is actuated by an eccentric which is driven or held by tension springs. (Udell, Inc. Supplements data on Pages 5393-5400, 1960-1961 Composite Catalog.)

***For more data, circle E2 on postcard***



## New Piranha Mill

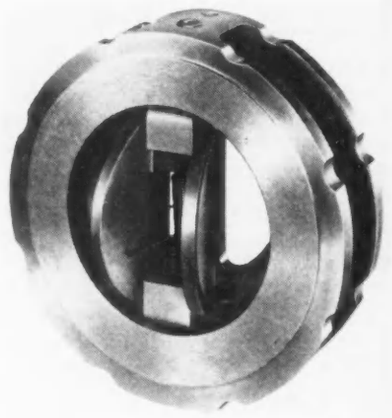
This new Piranha Mill was specifically designed to mill cemented tubing at high penetration rates, even when the tubing is alongside the casing wall. This new mill has three cutters in the ID that mill up the core of metal left by the regular cutters. When tubing is centered in the casing the Piranha cuts as a regular junk mill. Cutter blades are treated so they will cut from the bottom only. Piranha will not cut or damage the casing wall. (A-Z International Tool Co. Supplements data on Pages 97-116, 1960-1961 Composite Catalog).

***For more data, circle E3 on postcard***

## Triplex Plunger Pumps

Two new triplex plunger pumps for waterflood, salt water disposal and for general industrial use are available. New PQ and PS pumps are designed for continuous, full capacity operation in secondary oil recovery service. Also well suited for highpressure service in industrial applications. Features include: Colmonoy plungers, aluminum bronze wing-guided valves, direct drive through a double extended crankshaft. (Gardner-Denver Company. Supplements data on Pages 1993-2028 and 3549-3572, 1960-1961 Composite Catalog).

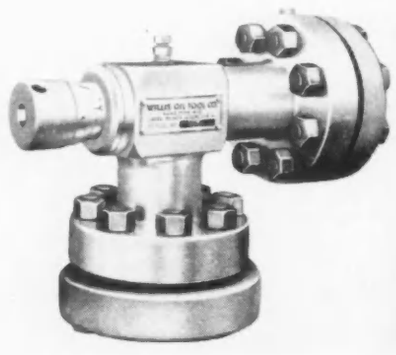
***For more data, circle E4 on postcard***



## Duo-Chek Valve

The "Duo-Chek" Valve fits between flanges and features new concepts in sealing to withstand all pressures. Duo-Chek averages 90 percent smaller than any other check valves of similar pipe size. New type resilient seal withstands all pressures without leaking or damage. Duo-Chek features an anti-slam spring closure that assures positive seating without slamming, yet opens with only ounces of pressure on the upstream side. (Mission Manufacturing Company. Supplements data on Pages 3757-3780, 1960-1961 Composite Catalog).

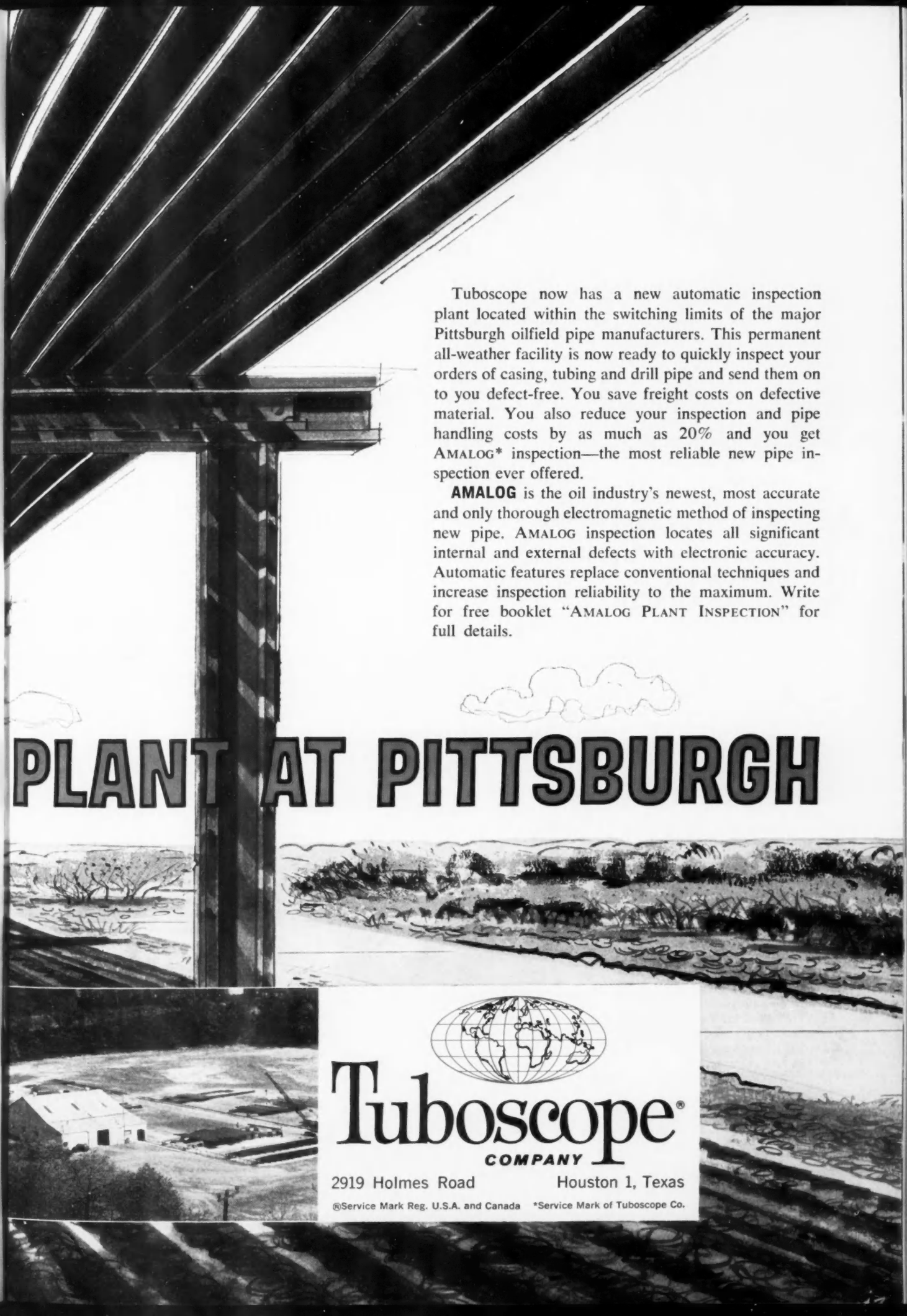
***For more data, circle E5 on postcard***



## Orifice Injection Valve

The Willis Multiple Orifice Injection Valve retains the advantages of a needle valve's micro-fine adjustments without their cutting and chattering disadvantages. Valve has low adjustment torque at high pressure and meters fluids from a minute flow to full line flow with less than a one-quarter turn of the stem. (Willis Oil Tool Co. Supplements data on Pages 5700-5704, 1960-1961 Composite Catalog.)

***For more data, circle E6 on postcard***



Tuboscope now has a new automatic inspection plant located within the switching limits of the major Pittsburgh oilfield pipe manufacturers. This permanent all-weather facility is now ready to quickly inspect your orders of casing, tubing and drill pipe and send them on to you defect-free. You save freight costs on defective material. You also reduce your inspection and pipe handling costs by as much as 20% and you get AMALOG* inspection—the most reliable new pipe inspection ever offered.

**AMALOG** is the oil industry's newest, most accurate and only thorough electromagnetic method of inspecting new pipe. AMALOG inspection locates all significant internal and external defects with electronic accuracy. Automatic features replace conventional techniques and increase inspection reliability to the maximum. Write for free booklet "AMALOG PLANT INSPECTION" for full details.

# PLANT AT PITTSBURGH

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COMPANY

2919 Holmes Road Houston 1, Texas

®Service Mark Reg. U.S.A. and Canada *Service Mark of Tuboscope Co.

# ANVIL Brand
## SPECIAL CLEARANCE TUBING COUPLINGS

Like all Anvil Brand oil field fittings, the special clearance coupling shown here makes up fast, saves time on-site. Consistently clean and accurate threads—electro-galvanized—are the reason. These special clearance couplings are painted overall according to A.P.I. color code; in addition, they bear a contrasting color band to indicate grade of string on which each should be used.
Anvil Brand Fittings—A.P.I. couplings for all regular oil field applications, bushings, plugs, and nipples— undergo scientific materials testing and continual gaging during manufacture. They are sold through your nearest supply store, whose engineering service to customers is supported by Anvil Brand Representatives in key locations. Write today for further information.

*Home office and main plant: Allison Park, Pa. Anvil Brand Couplings are also manufactured by Anvil Products, Inc., Longview, Texas, and by Canadian Coupling and Fittings, Ltd., Simcoe, Ont., Canada.*

P·E·S·A PARTNERS IN PETROLEUM PROGRESS

forged seamless and wrought steel pipe fittings

ANVIL

**PITTSBURGH**
**PIPE AND COUPLING COMPANY**
ALLISON PARK PA., U.S.A.


## New equipment

### New Formation-Type Bit

This new formation-type bit VH2-G is designed for faster drilling of medium hard formations such as drilling in shale, slate, hard anhydrites and limestone. The new bit has chisled teeth with a reinforcing L on the gage reinforced with "Varelloy" tungston carbide. It fills the gap between the Varel VH1 and V2. It is available in sizes 7⅞, 8¾ and 9 inches. (Varel Manufacturing Company. Supplements data on Pages 5433-5452, 1960-1961 Composite Catalog).

***For more data, circle E7 on postcard***

### Well Stimulation Technique

This new stimulation method extends the advantages of acidizing. Treatment consists of high-speed injection of a special slow-reacting acid. Solution does not contain sand; is pumped into the formation at pressures capable of opening natural fissures in the rock, allowing the acid to penetrate appreciable distances from the well bore. At the same time, the acid attacks the exposed rock surfaces, dissolving away the more soluble portions and leaving the surface rough and furrowed. (Dowell, Division of The Dow Chemical Company.)

***For more data, circle E8 on postcard***


# Best Break Yet!
## FOR DRILL COLLARS & TOOL JOINTS

JET-LUBE WORLD WIDE

Full string service "from Swivel to Bit." Outstanding anti-seize and sealing properties. Exclusive formula. Mfd. under U.S. Pat. No. 2,543,741

JET-LUBE INC. Burbank, Calif.

EXPORT OFFICE:
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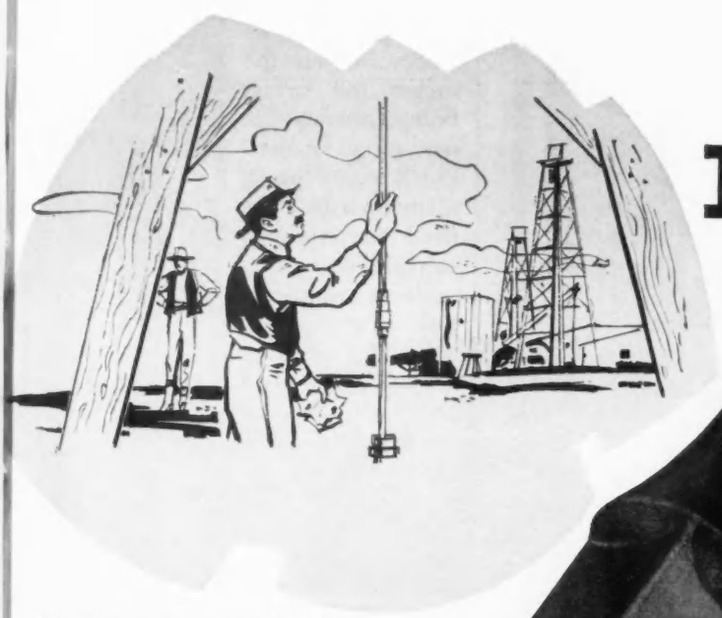
# JONES

## FIRST IN 1894...



The oldtimer's way of telling how a well was pumping was by feeling the polished rods. Long ago Jones developed more scientific methods to learn about the mechanics of pumping with sucker rods.

## FIRST TODAY...

A good many years ago Jones developed a well weighing dynamometer plus the technical knowledge to diagnose the pumping problems of troublesome oil wells and to suggest remedial action. This is the type service you can expect from a **Sucker Rod Specialist!**

## ...because we're Sucker Rod Specialists!

There are four
JONES JOB-ENGINEERED SUCKER RODS...
a type for every pumping need!

**THE S. M. JONES COMPANY**

Division of Buffalo Eclipse Corporation

General Office and Factory: TOLEDO, OHIO

Sales Office: Enterprise Building, TULSA, OKLAHOMA

Export Sales Representatives:

IDECO, One of the Dresser Industries, Dallas—New York

Franklin Supply Company, Export Division, Inc., New York

PERFORATE TUBING IN THE WELL

KINLEY TUBING PERFORATOR

J. C. Kinley Co. Licensees

ABILENE, TEXAS—Hudson Eads, Inc....OR 2-5331
ANACO, ANZOATEGUI, VENEZUELA
Anzoategui Wire-Line Service, C. A.
BAY CITY, TEXAS—J. P. Graham.....CI 5-4526
CABIMAS, ZULIA, VENEZUELA
Wireline Engineers, S. A.
CASPER, WYOMING—C. A. White.....3-5264
CORPUS CHRISTI, TEXAS—Tolle, Inc...TE 5-5367
CORPUS CHRISTI, TEXAS
J. D. Ball Wire Line Service Co.... ....TU 3-7762
FARMINGTON, NEW MEXICO
B & R Service, Inc.....DA 5-2393
FORT MORGAN, COLORADO—C. A. White....919
GLENDIVE, MONTANA—C. A. White...EM 5-3833
HOBBS, NEW MEXICO
Horne Well Service Co.....3-5396
HOUMA, LOUISIANA
Assoc. Eng. & Equip., Inc.....UP 2-0347
HOUMA, LOUISIANA—Camco, Inc.....7330
HOUMA, LOUISIANA
Fred Haynie Oil & Gas Well Service...UP 3-7885
HOUSTON, TEXAS
Mid-Western Well Ser. Co.....RE 4-4262
HOUSTON, TEXAS
Long Line Production Control.....GR 3-5739
LAFAYETTE, LOUISIANA—Camco, Inc. CE 5-3124
LIBERAL, KANSAS—Rainbo Service...Main 4-3598
MIDLAND, TEXAS
Lucous Service & Eqpt. Co.....MU 2-8311
NEW IBERIA, LOUISIANA
Cardinal Wireline Specialists, Inc.....EM 4-5165
NEW IBERIA, LOUISIANA
Klein-Deco Wire Line Service.....EM 9-6632
ODESSA, TEXAS
Camco Wire Line Service, Inc.....FE 2-6497
ODESSA, TEXAS
John Kuykendall Wireline Service Co...FE 7-7210
OKLAHOMA CITY, OKLAHOMA
Rainbo Service Co.....ME 4-2131, ME 4-0105
PETTUS, TEXAS
Eddie Jones Eng. Co., Pettus 16, Beeville.FL 8-1218
SHREVEPORT, LOUISIANA—Camco, Inc....8-3615
VICTORIA, TEXAS—Camco, Inc.....HI 3-9521
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322-8584, 322-1792, 767-8727, 723-4690, 767-3793

Announcing the new

MILLER

"SLIM HOLE" SAND PUMP

Miller 2" OD Sand Pumps for 2⅞" OD "Slim Hole" completions are now available. The 2" OD Sand Pump, with accurately machined lug-type bottoms, is designed exactly the same as larger Miller Sand Pumps.

SAND PUMP SIZES

O.D—2, 2⅛, 3, 3⅛, 4¼, 5, 5⅛, 7 in.

Lengths—20, 25, 30 ft. for 3" OD and larger pumps. 20 and 25 ft. for 2⅛" pump. 20 to 24 ft. for 2" pump.

Composite Catalog, Page 3688
Write for descriptive price list

MILLER SAND PUMPS

Miller Sand Pump Co.

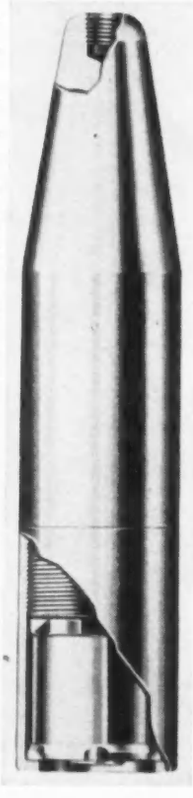
General Offices, Box 4516
Oklahoma City 9, Okla.

EXPORT OFFICES
30 Rockefeller Plaza
NEW YORK CITY 20, N. Y.

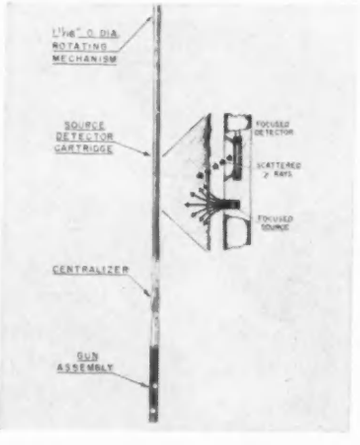
# New equipment

## New Magnetic Element Tool

A new magnetic tool has been made available which increases the versatile uses of junk catchers. This assembly is converted from a 2-in-1 to a 3-in-1 tool, making it ideal for standby duty on any rig. Sinker bar and head encompass the standard magnetic element, making it suitable for sand line operation. Its design makes it safe to run in any hole without danger of "hanging up." (Globe Oil Tools Co. Supplements data on Pages 2105-2124, 1960-1961 Composite Catalog).



***For more data, circle E9 on postcard***



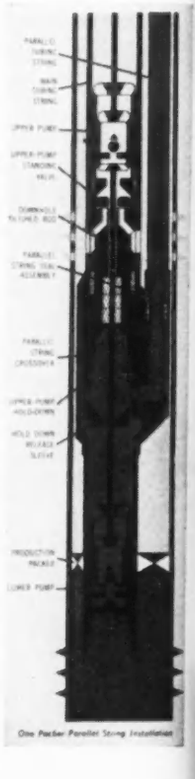

## Single Line Equipment

Oriented perforations, necessary in multiple tubingless completions, can be accomplished on this single line equipment. A radiation sensing device, a rotation mechanism, and a Schlumberger Scallop Gun or Ribbon Jet Perforator are combined to perform the operation on a single trip in the well. Advantages include: Requirements in surface equipment and operating time are reduced; adjacent strings need not be open, sucker rods or other well equpipment may remain in place. (Schlumberger Well Surveying Corporation. Supplements data on Pages 4849-4868, 1960-1961 Composite Catalog).

***For more data, circle E10 on postcard***

## Two-Zone Subsurface Pump

A new D + B two-zone subsurface pump featuring an exclusive upper-pump standing valve has been introduced. Valve enables the complete pump to be retrievable on the sucker rod string. Pump permits the use of standard D+B pump parts, eliminating the need for special equipment. Sealing surfaces are of carbide material to provide maximum resistance against corrosion, sand and fluid cutting. (Continental-Emsco Co., a Division of Youngstown Sheet & Tube Co. Supplements data on Pages 1397-1484 & 1485 & 1549, 1960-1961 Composite Catalog).




***For more data, circle E11 on postcard***

## New Control System

A new concept in control systems for automatically starting, loading and shutting down internal combustion engines has been announced. System is inherently explosion-proof. The "building block" concept provides maximum versatility and is the basis of engineering the systems to fit any anticipated engine requirements. All measurable variables are monitored continuously. Variables include temperatures, pressures, liquid levels, vibration and engine speeds. (Fulton Sylphon Division, Robertshaw-Fulton Controls Company.)

***For more data, circle E12 on postcard***

**NOW—ANOTHER DRILLING AID FROM MILWHITE**

# CHEK-LOSS

## The Loss Circulation Product Whose Elasticity Gives You a Better Seal Under Pressure

. . . when compressed, conforms to the shape of the containing body and effects a more permanent, effective seal.

**BEFORE PRESSURE**

Photomicrograph of Chek-Loss under atmospheric conditions (note voids between particles).

**UNDER PRESSURE**

Photomicrograph of Chek-Loss when compressed (note the voids between particles have been decreased due to its elasticity).

**CHEK-LOSS**

- Is Chemically Inert in All Systems of Mud
- Is Unaffected by Oil
- Is Heat Stable
- Is Long Lasting
- Is Non-Abrasive

**MILWHITE**

**MUD SALES COMPANY**

HOUSTON, TEXAS

DIVISION OF MISSISSIPPI RIVER FUEL CORPORATION

*Drilling Progress Through Mud Research Is Continuous at Milwhite.*

# 1260 horsepower to put where you please

## The Ruston skid-mounted 'TA' gas turbine is the lightest long-life power package ever!

Here's a rugged lightweight unit for pump, compressor, or generator drive . . . 1260 reliable horsepower available two minutes after pressing the starter button. All the auxiliaries are mounted on the skid and the complete air-cooled unit weighs only 18,000 lb.

Whether mounted on a drilling platform or sitting on only 6″ of concrete, this Ruston 'TA' will run unattended in conditions from Arctic cold to tropical heat . . . existing installations show that overhaul periods are way over 10,000 hours.

The skid-mounted 'TA' is a new concept in packaged power . . . the kind of lightweight heavy-duty unit oilmen have been waiting for. Write to Rustons to learn how it can help you.

**. . . PLUS FREE HEAT!**

'TA' exhaust heat can produce:

**50,000** gallons of distilled water daily.

**10,000** lb steam per hour.

**12,000** gallons an hour of feed water for existing boilers.

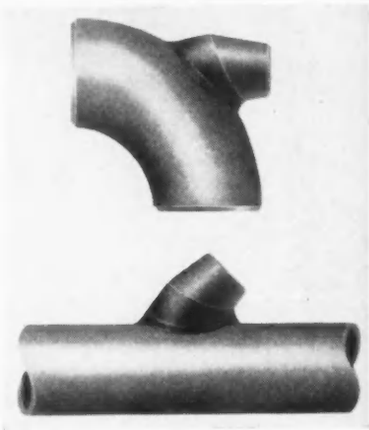
**RUSTON GAS TURBINES**

430 and 1260 b.h.p. at 80° F. ambient temperature

**RUSTON & HORNSBY LTD • LINCOLN • ENGLAND**

*Associated with Davey, Paxman & Co. Ltd., Colchester*

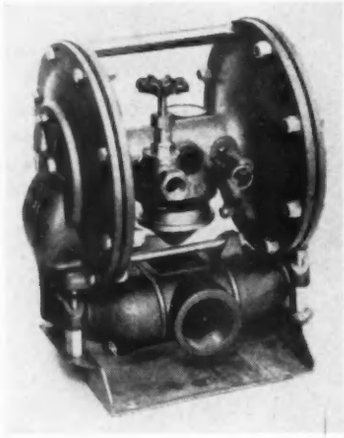

## *New equipment*



### New Angle Fitting

A new angle fitting, the Elbolet, is being produced for use in attaching branch outlets at bends in piping systems. Elbolet can also be used for angled connections to straight lines. Primary design is that it provides substantially improved flow conditions compared with a 90 degree branch intersection made in any manner. Combination of angles on both the inside and outside enable a full penetration weld even in the most acute angle section between the fitting and the run pipe. (Bonney Forge and Tool Works).

***For more data, circle E13 on postcard***

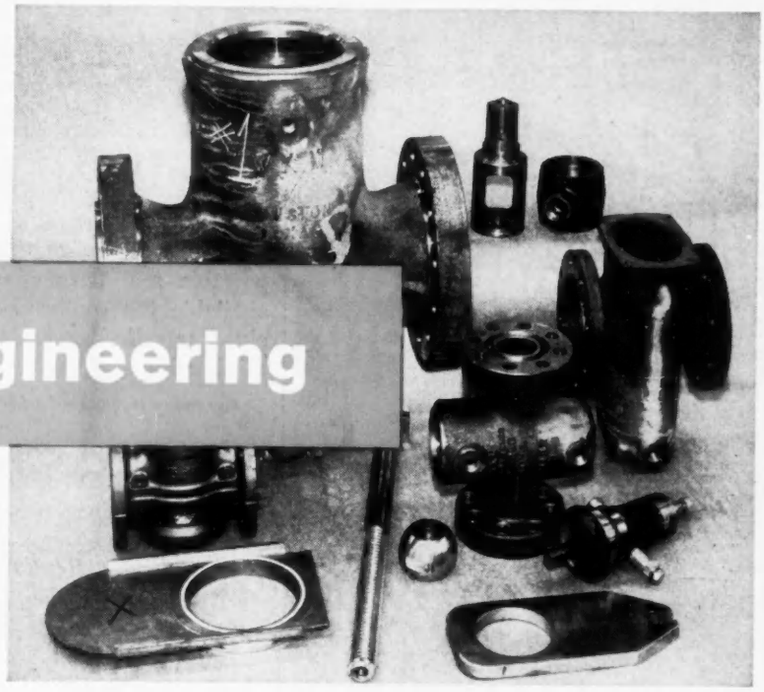


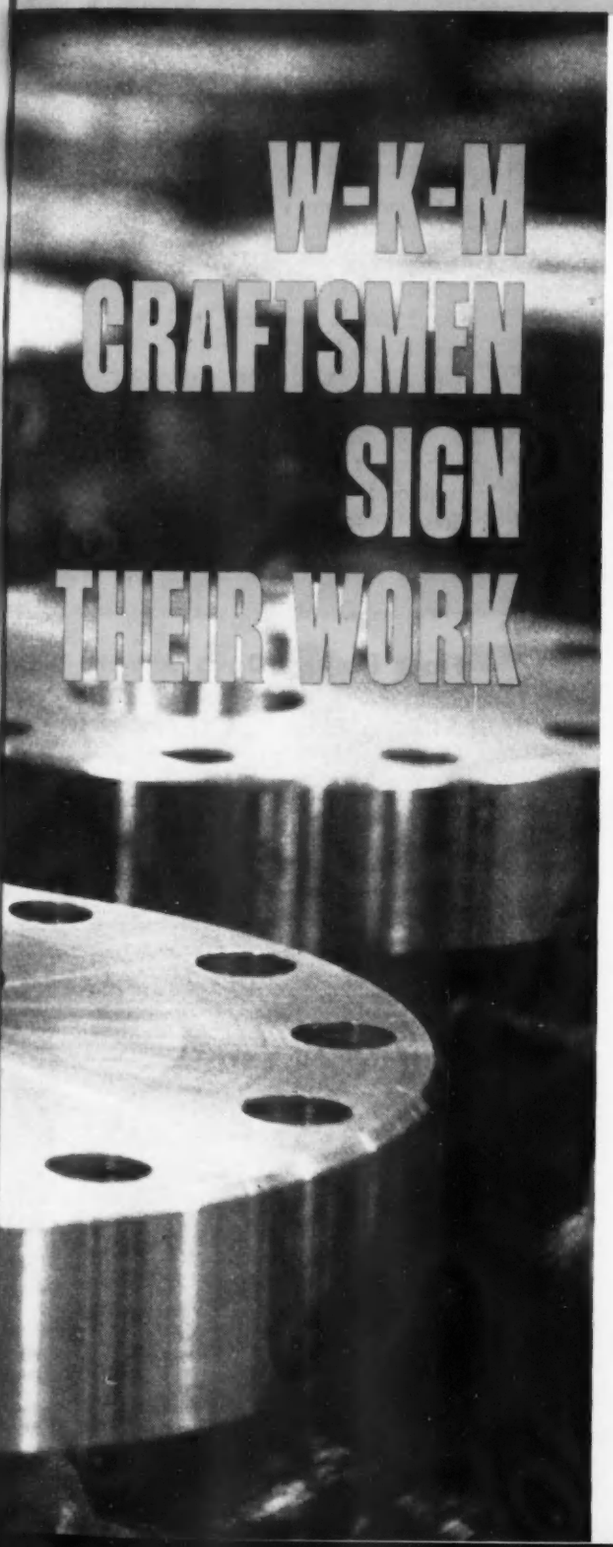
### Air or Gas Operated Pump

This new type, air or gas operated, double diaphragm, utility pump has been introduced. A portable unit, operated on air or gas pressure from 5 to 100 psi, it provides closely controlled discharge volumes from 1 to 60 gallons per minute. Double acting diaphragm design handles solvents, slurries and even liquids containing solids to ¼ inches in diameter with ease. (Texsteam Corporation. Supplements data on Pages 5198-5199, 1960-1961 Composite Catalog.)

***For more data, circle E14 on postcard***

# TOTAL Valve Engineering






4 / 41 / 89 / 16 / 12 / 2 / 17
98 / 13 / 65

## What these "Hallmarks of Quality" on the parts of every W-K-M Valve mean

Examine any important part and you'll find stamped in the metal the *personal* seal of each W-K-M craftsman who worked on it.

These marks denote a pride of workmanship that gives you greater assurance of trouble free service. For quality must be built into a valve on the *production line* as well as on the drawing board.

To achieve the unique personal responsibility of every man, at W-K-M takes *human* engineering. It is a vital part of TOTAL Valve Engineering—W-K-M's unique dedication to *all* phases of valve technology. Another reason why W-K-M Valves work better, last longer . . . on the world's toughest jobs.

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**DARCOVA**
**now offers...**

- MORE STRENGTH
- MORE LIFE
- MORE PERFORMANCE PER DOLLAR

**with 100% NYLON COMPOSITION!**

and *only* in DARCOVA can you get this time-saving, money-saving advantage! Available in the full range of sizes and Darcova textures for varying well conditions.

Send for Bulletin No. 5502
and specify DARCOVA at your supply store.
There *is* no substitute!

**DARLING VALVE & MANUFACTURING COMPANY**
DARCOVA ®
WILLIAMSPORT 28, PA.
THE ORIGINAL COMPOSITION CUP


# New literature

**To get your copies, circle key numbers on postcard and mail to WORLD OIL.**

## Meter Station Bulletin

Daniel Orifice Fitting Company has released a new four-page brochure, MS-1, describing a variety of packaged orifice meter stations, both portable and permanent, which are available for wellhead gas metering, city-gate sales, power plants or transmission installations.

***For more data, circle E15 on postcard***

## Line Pipe Brochure

A new brochure that outlines specifications and other facts about line pipe produced by The Youngstown Sheet and Tube Company has been issued. Designed for easy access in the file drawer, the brochure contains a graphic description of the three methods by which Youngstown makes line pipe—continuous weld, seamless and electric weld. One section is devoted to the hydrostatic expansion process which imparts precise sizing and improved weldability and bendability to electric weld line pipe.

***For more data, circle E16 on postcard***

## Revised Orifice Catalog

Daniel Orifice Fitting Company has published a revised, 36-page edition of their Catalog Section A, on Senior Orifice Fittings. Catalog includes parts illustrations which show a new equalizer valve and stuffing box and complete installation, operation and maintenance instructions for Senior fittings.

***For more data, circle E17 on postcard***

## Automatic Lubricator Folder

An automatic lubricator for lubricated plug valves is described in a new bulletin issued by The Rockwell Manufacturing Company. Booklet shows the construction of the lubricator, tells how to install and operate it and gives information necessary for the device's adjustment.

***For more data, circle E18 on postcard***

## Pneumatic Controllers

The Bristol Company has released Bulletin DM058, describing Bristol's new Series 624 Indicating Pneumatic Controllers. The new A/D Control Unit is featured. Bulletin includes specifications for the instrument, models are listed for controlling pressure, vacuum, liquid level, flow, temperature and humidity.

***For more data, circle E19 on postcard***

## Subsurface Pump Brochure

Harbison-Fischer Manufacturing Co. has published a new, illustrated bulletin on its line of "Little Squirt" subsurface pumps for slimhole completions using 1¼-inch or 1½-inch tubing. The literature contains illustrations of each complete pump assembly, alternate plungers and parts and accessories.

***For more data, circle E20 on postcard***

## New Rig Bulletin

The National Type 80-B consolidated Rig is described and illustrated in Bulletin No. 516, just published by The National Supply Company. The 16-page bulletin contains over-all photographs of the rig and close-ups of various components. Also includes engineering and operating specifications, a shaft speed diagram, a typical foundation plan and a performance curve.

***For more data, circle E21 on postcard***

## Flow Pumps Data Sheet

Complete information on its 25 to 2,400 hp direct flow pumps is contained in Data Sheet 100, now available from the Aldrich Pump Co. The two-color folder features the Aldrich triplex (3 plungers), quintuplex (5 plungers), sextuple (7 plungers) and the nonuplex (9 plungers) reciprocating pumps. Also described is the Aldrich-Groff "Power-Savr" pump.

***For more data, circle E22 on postcard***

## Pump Motors Booklet

GEA-6546E, six-page booklet, from General Electric Co., describes features of new 3 to 75 hp, high-torque, high-slip Tri-Clad "55" pump motors. Booklet contains explanations on how the motor's high torque overcomes unusual load conditions and eliminates "rocking the beam." Booklet contains rating and dimension data and cutaway views showing internal construction.

***For more data, circle E23 on postcard***